MARY'S HARBOUR, LABRADOR

MINI-HYDRO DEVELOPMENT

Feasibility Study

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Prepared by:

Newfoundland and Labrador Hydro

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NEWFOUNDLAND AND LABRADOR HYDRO

MARY'S HARBOUR

MINI-HYDRO DEVELOPMENT

FEASIBILITY STUDY

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ETUDE DE FAISABILITE D'UNE MINI-CENTRALE HYDRO-ELECTRIQUE A MARY'S HARBOUR (T.-N.)

Résumé pour la direction

L'étude en question a été effectuée par la Newfoundland and Labrador Hydro en vertu du Programme de démonstration dans les collectivités éloignées du ministère de l'Energie, des Mines et des Ressources du Canada.

Le ministère des Affaires municipales de Terre-Neuve et du Labrador poursuit ses travaux d'aménagement d'un système d'adduction et d'épuration de l'eau pour la collectivité de Mary's Harbour au Labrador. Sur le site prévu pour le barrage, il serait possible de construire une mini-centrale hydro-électrique.

Le site avait déjà été déterminé dans une étude préparée par ShawMont Newfoundland Limited et portant sur les possibilités de construction de centrales à échelle réduite à Terre-Neuve et au Labrador ("Study of Small Scale Hydro", Rapport de ShawMont n°SM-2-79).

L'approbation d'un système d'adduction et d'épuration de l'eau à Mary's Harbour par le ministère des Affaires municipales offrait l'occasion d'examiner à nouveau les installations prévues dans l'optique d'un projet conjoint fondé sur l'utilisation commune de ces installations.

La présente étude avait pour objet de déterminer la faisabilité et la rentabilité d'un projet de combinaison d'une mini-centrale hydro-électrique au système d'adduction et d'épuration de l'eau de la collectivité.

L'étude a été financée conjointement par le ministère fédéral de l'Energie, des Mines et des Ressources, le ministère des Affaires municipales de Terre-Neuve et du Labrador et Newfoundland and Labrador Hydro.

L'entreprise Sheppard, Hedges and Green Ltd. a étudié les installations communes, raffiné leurs exigences et établi les coûts finals du système d'adduction et d'épuration de l'eau.

Les conclusions sont:

1. Sur le plan technique, il est possible de construire une mini-centrale hydro-électrique en la combinant au système d'adduction et d'épuration de l'eau à Mary's Harbour.

2. Une mini-centrale hydro-électrique peut être construite parallèlement au système d'adduction et d'épuration de l'eau et il suffit d'embrancher une canalisation d'eau à la conduite forcée, près de l'emplacement proposé du bâtiment des machines.

3. Les installations communes sont:

   -la route entre la collectivité et le site

   -le barrage

   -la prise d'eau

   -le passage à poissons

   -la partie de la canalisation d'eau comprise entre le bâtiment des machines et le barrage.

   Selon les estimations, les coûts totaux directement attribuables à ces installations communes atteindraient 346 000 $ en dollars de 1983.

   Les avantages rattachés à l'exploitation commune de certaines installations ainsi que les économies de coûts relatives au barrage, à la prise d'eau et au passage à poissons sont limités en raison de diverses exigences propres à chaque projet. Le barrage hydro-électrique et le passage à poissons représentent des travaux de plus grande envergure que ceux qu'exigerait le projet de système d'adduction et d'épuration de l'eau, principalement en raison du grand diamètre de la conduite forcée et des critères de submersion.

   Les économies les plus importantes sont réalisées au niveau des coûts de la conduite forcée et de la route d'accès. Pour profiter le plus possible des économies découlant de la voie d'accès, il faut réorganiser les travaux de construction prévus à l'étape I du projet d'adduction et d'épuration de l'eau afin que cette voie soit aménagée avant la mise en chantier du projet de mini-centrale hydro-électrique.

   Les deux projets ont été analysés au cours de l'étude afin de définir plus rigoureusement les exigences relatives au barrage et au passage à poissons et de tirer tous les avantages possibles des deux projets, ce qui a permis de bien délimiter les deux projets pour comparer les installations communes.

4. Selon les estimations, le coût d'immobilisation total de la mini-centrale hydro-électrique serait de 3 024 000 $ si ce projet était distinct de celui du système d'adduction et d'épuration de l'eau.

   Si la construction des installations communes était un projet conjoint, le coût d'immobilisation total du projet de mini-centrale hydro-électrique serait de 2 454 000 $. Les économies totales réalisées au cours des deux années du projet conjoint s'élèveraient à 570 000 $. Toutefois, ce montant peut varier selon les fonds disponibles durant la période de construction.

5. Un calendrier des travaux de construction de la mini-centrale hydro-électrique a été dressé en supposant que le projet serait approuvé le 1er mai 1984. Les travaux de construction proprement dits seraient effectués en 1985 afin de disposer de suffisamment de temps pour les travaux de conception et le délai de livraison relativement long de la turbine et de la génératrice. La date fixée pour la mise en service de la mini-centrale est le 30 novembre 1985. Il faudrait que les travaux de construction soient achevés en une saison; toutefois, la marge de manoeuvre est très limitée puisque les responsables des pêcheries exigent que les travaux de construction obstruant le cours d'eau (bâtardeau et barrage) ne soient pas entrepris avant le mois d'octobre.

6. Le projet de mini-centrale hydro-électrique peut avoir certaines répercussions sur le milieu mais des études préliminaires laissent à entendre que des mesures peuvent être prises pour atténuer ces répercussions. L'aspect écologique qui suscite le plus d'inquiétude est l'effet du projet sur la migration des poissons. Cet effet peut être atténué par l'aménagement d'un passage à poissons et par un écoulement d'eau compensatoire durant une certaine partie de l'année. L'établissement d'un calendrier de construction qui tient compte de la période critique de migration des poissons est un autre moyen efficace d'atténuer les répercussions.

7. En l'absence de crédits supplémentaires, sous forme de projet en coparticipation ou de subventions directes, la rentabilité du projet de la mini-centrale hydro-électrique à Mary's Harbour est marginale (le seuil de rentabilité n'est atteint qu'après 27 ans). S'il en est ainsi, il est peu probable que la Newfoundland and Labrador Hydro poursuive le projet. Selon les estimations actuelles des coûts d'immobilisation, les crédits supplémentaires requis pour accroître la viabilité du projet varieront entre 767 000 $ et 2 079 000 $. Notons que ces projections tiennent compte de l'exploitation commune de certaines installations prévues dans le projet d'adduction et d'épuration de l'eau ainsi que de toute subvention en vertu du Programme de démonstration dans les collectivités éloignées.

1 INTRODUCTION

.1 General

The study reported herein was undertaken by Newfoundland and Labrador Hydro under the Remote Community Demonstration Program of the Department of Energy, Mines and Resources, Canada.

The Department of Municipal Affairs of the Province of Newfoundland and Labrador are proceeding with a water supply and sewage system for the community of Mary's Harbour, Labrador. At their proposed dam site there is potential for a mini-hydro development.

The hydro site was previously identified in the Newfoundland and Labrador inventory "Study of Small Scale Hydro" prepared by ShawMont Newfoundland Limited. Shawmont Report # SM-2-79.

The approval of the water supply and sewage system for Mary's Harbour by the Department of Municipal Affairs presented a new opportunity to review the Hydro project in relation to a joint development utilizing common facilities.

The purpose of this study was to determine the technical and economic feasibility of the mini-hydro development with the integration of the mini-hydro project with the community water supply and sewage system.

The study was jointly funded by the Department of Energy, Mines and Resources, Canada, the Department of Municipal Affairs of the Province of Newfoundland and Labrador, and Newfoundland and Labrador Hydro.

.2 Proposal and Agreements

Newfoundland and Labrador Hydro submitted a proposal for a study of a mini-hydro development at Mary's Harbour, Labrador, under the Remote Community Demonstration Program in a letter to the Department of Energy, Mines and Resources, Canada dated 1983 04 12.

A study agreement was approved by the Department of Energy, Mines and Resources, Canada in their letter to Newfoundland and Labrador Hydro dated 1983 07 26.

.2 Proposal and Agreements (cont'd.)

A separate agreement on funding was approved by the Department of Municipal Affairs of the Province of Newfoundland and Labrador in their letter of 1983 04 13 from the Minister to the Department of Energy, Mines and Resources, Canada.

.3 Study Approach

The study was carried out in three stages as follows.

- Stage I - Attain Information
  - Compile topographical information.
  - Compile hydrological information.
  - Visit site. Survey site to obtain topographical information and to locate structure sites. Check local availability of construction materials.

- Stage II - Process Information
  - Complete hydrology study.
  - Complete power and energy study, taking into account project energy demand and winter flow conditions.
  - Prepare conceptual sketches of structures.
  - Prepare construction schedule.
  - Prepare cost estimate.

- Stage III - Compile Information into Report Form
  - Prepare feasibility report. It is to include a description of the project.
  - Prepare cost effectiveness analysis for various levels of funding.
  - Give a copy of the final report to the Community. If the Community so wishes, Newfoundland and Labrador Hydro will make a presentation on the study to the Community.

.3 Study Approach (cont'd.)

The study schedule for the work was as follows.

Stage I - August 15, 1983 to September 15, 1983

Stage II - September 15, 1983 to October 30, 1983

Stage III - October 30, 1983 to February 29, 1984

During work on the water supply and sewage system, the firm of Sheppard, Hedges and Green Ltd. carried out engineering survey work including centerline profiles for the dam site, pipeline/penstock route, and powerhouse site. This survey information was made available by Sheppard, Hedges and Green Ltd. and was used in Stage I of the study. A reconnaissance site visit was made by Newfoundland and Labrador Hydro staff to confirm structure locations, obtain topographical information, and check on local availability of construction plant and materials.

.4 Meeting with Sheppard, Hedges and Green Ltd.

During the study a meeting was held with Mr. Charlie Sheppard of Sheppard, Hedges and Green Ltd to review the aspects of each project, identify common facilities and associated costs. Subsequently, Sheppard, Hedges and Green Ltd. reviewed the common facilities and optimized on their requirements and provided the final costs associated with the water supply and sewage system.

.5 Cost Effectiveness Analysis

This study addresses the economics of the hydro development with and without savings from common facilities and/or additional funding becoming available to the mini-hydro project.

The main scenarios considered in the economic analysis are:

(a) Economics of hydro development alone.

(b) Economics of hydro development with total savings from common facilities.

.5 Cost Effectiveness Analysis (cont'd)

(c) Economics of Hydro development with 50% savings from common facilities.

(d) What additional funding, if any, is required to make the project have a cross-over date of 5, 10, and 15 years.

2 SUMMARY AND CONCLUSIONS

(a) Integration of a mini-hydro development with a community water supply and sewage system at Mary's Harbour, Labrador is technically feasible.

(b) A mini-hydro development can be built in conjunction with a proposed water supply and sewage system and a water main can be simply tapped off the penstock near the proposed powerhouse site.

(c) The common facilities of the projects are:

(1) Road from Community

(2) Dam

(3) Intake

(4) Fishway

(5) A section of water main between the powerhouse and dam.

The total direct cost (1983 dollars) of these common facilities is estimated at $346,000.

The common facilities and subsequent cost savings associated with the dam, intake and fishway are somewhat limited by different specific requirements of each project. The hydro dam and fishway are much more extensive than those required for the water supply and sewer project mainly due to the large diameter of penstock and submergence requirements.

The major cost savings are in the pipeline and access road. To best utilize the savings from the access road, construction must be rescheduled in Stage I of the water supply and sewage system project so that access is available prior to the start of the hydro project.

Both projects were reviewed during the course of the study to minimize dam and fishway requirements and to optimize each project, thus placing both projects in their proper perspective for comparison of common facilities.

(d) The total capital cost estimate for the mini-hydro development, if built independently of the water supply project is $3,024,000, as detailed in Section 11.

2 SUMMARY AND CONCLUSIONS (cont'd.)

(d) (cont'd.)

The total capital cost for the same project realizing the common facilities is $2,454,000. The total savings over the two year period of the project is estimated at $570,000. T[illegible]gure may vary depending on availability of funding during the construction period.

(e) A construction schedule was developed for the mini-hydro development based on a project release date of May 1, 1984. The actual construction would be carried out in the 1985 construction season to allow time for design and realizing the relatively long turbine/generator delivery period. The on-power date is November 30, 1985. It is felt that the construction work must be completed in one season; nowever, the schedule is extremely tight mainly due to fisheries restrictions which require that cofferdam and in-stream dam construction not proceed until after September.

(f) The nydro project does pose environmental concerns, but preliminary investigations indicate that the concerns can be resolved with mitigative action. The major item of environmental concern is that of fish passage. This can be mitigated by provision of a fishway and the release of a compensating flow during part of the year. Scheduling of construction around the critical fish passage period is also an effective means of mitigation.

(g) Without additional funding in the form of a joint development or direct subsidy, the Mary's Harbour mini-hydro development is marginally cost-effective (i.e. cross-over occurs after 27 years). Under these conditions it is unlikely that Newfoundland and Labrador Hydro would proceed with the project. A projection of the level of additional funding required to improve the project's viability is between $767,000 and $2,079,000 based on the present estimate of capital cost. This, of course, includes common facilities from the water and sewer project and any funding available under the Remote Community Demonstration Program.

3 DESCRIPTION OF STUDY AREA

.1 Location and Access

Mary's Harbour is a coastal community located in southern Labrador, 55°52' W, 52°18' N (See Dwg. B1-3119-1). Access to the community is by air and sea only. The community has a gravel airstrip and is serviced by scheduled Labrador Airways' flights originating from Deer Lake, Newfoundland. The marine access is solely by scheduled Canadian National coastal boats. Usual marine shipping originates in Lewisporte or St. John's, Newfoundland, on a 7 - 10 day basis. This service runs from early June to late November.

.2 Scope of Development

The proposed development is located approximately one km west of Mary's Harbour. The project will involve the construction of a number of civil works including:

(a) a concrete overflow dam spillway and fishway,

(b) an intake structure,

(c) a penstock,

(d) a 280 kW powerhouse,

(e) an access road,

(f) a 12.5 kV transmission line

The concrete overflow dam and spillway will be located at the top of White Rock Falls. It will be 3 meters in height, and will raise the level of the small upstream pond from elevation 14 meters to 17 meters FSL. At present, the pond is 2.55 ha in area. At the full supply level of 17 meters, the reservoir will be 3.11 ha larger, extended to a total area of 5.66 ha. Under maximum flood conditions (1 in 100 year), the reservoir area will be 6.85 ha. A fishway over the dam has been proposed for the north side of the existing river channel.

.2 Scope of Development (cont'd.)

The intake structure will be constructed on the north side of the river. A penstock, 1.2 meters in diameter, will carry water 240 meters downstream to the powerhouse. Its maximum rated flow capacity is 3.8 m^3/s. The powerhouse will contain a 280 kW turbine and generator, operating under a minimum head of 10.0 meters.

An access road, 1.1 kilometer in length, will be constructed to link the site with the community of Mary's Harbour. A 12.5 kV transmission line will be constructed in the same right of way interconnecting with the existing community power grid.

It is proposed that this project would be completed in one construction season. The earliest possible completion date of the project would be late 1985.

.3 Hydrology

The St. Mary's River drainage area is 473 km^2. Monthly and annual discharge data are not available. However, data have been transposed from the Eagle River, the nearest gauged river with a long term record (1966 - 1982). Mean annual flow is estimated to be 11.7 m^3/sec. with a low of 1.7 m^3/sec. in March to a high of 42.8 m^3/sec in June during snowmelt runoff.

.4 Climate

Banfield (1981) included Mary's Harbour in his Coastal Labrador climatic zone. The climate of this area is less continental than the interior, with more frequent storms and stronger winds. Annual precipitation is approximately 1 300 mm with a maximum in winter. Between 300 mm and 400 mm of the total annual precipitation falls as snow. Summers can be very warm during offshore southwesterly flows, but cold with onshore circulations. Mean daily temperatures in February, April, July and October are -12^oC, -1^oC, 12^oC, and 4^oC, respectively.

.5 Geology

Ricketts and Bragg (pers. comm.) have recently conducted an aggregate survey of the areas surrounding coastal Labrador communities. The

.5 Geology (cont'd.)

bedrock geology of the proposed development area is granitic, and is composed primarily of massive white micaceous granite and granitic gneiss. Bedrock outcrop is common. They also emphasized the distinct lack of substantial glacial deposits. The surficial geology is composed of a very thin, discontinuous cover of till of glacial origin. This till predates late Wisconsin glaciation, at which time this area was apparently ice-free (Rogerson, 1983).

The physiography of the area is predominated by large scale streamlined bedrock features, products of extensive glacial erosion. Relief in the development area is between 0 and 40 m.

.6 Vegetation

Wilton (1965) recognized the rapid changes in forest vegetation in the coastal regions of southeastern Labrador. Within 5 km of the coast, there is a transition from coastal barrens, through the scrub and sub-marginal forest zone, fair and marginal forest zone, to the good boreal forest zone. The proposed development site is located in the fair and marginal forest zone. However, in 1959, an extensive forest fire decimated these existing forests. There is a very small remnant stand of black spruce (Picea mariana) and balsam fir (Abies balsamea) on the north side of the proposed reservoir. These are widely spaced and small in diameter, and are for the most part, less than 8 meters in height. The remainder of the local area is a burnt over soil and rock barren, with no forest regeneration apparent. Vegetation here is typical of heathlands in the area, primarily mosses, lichens and ericaceous shrubs.

.7 Community

Mary's Harbour is a small community of approximately 450 people. A smaller community of Lodge Bay soon to be connected with Mary's Harbour by road has an approximate population of 125. The community has relied traditionally on trapping, forest resources and the fishery. At present, the fishery is a mainstay of the economy, with summer migration to the fishing stations of Battle Harbour, Indian Cove, Matthews Cove, Camp Island, Carrol's Cove and Henley Harbour.

.7 Community (cont'd.)

Mary's Harbour acts as a sub-regional administrative centre for this area of southeastern Labrador coast. The community has a branch office of the Provincial Department of Social Services and a detachment of the R.C.M.P. which services the communities from Charlottetown to Lodge Bay. The medical facilities serve communities from Fox Harbour to Lodge Bay.

The community is served by as many as 10 small general store/repair shop type businesses.

See Appendix D for a complete community profile (an exerpt from "Remote Community Demonstration Program - Newfoundland Region - Overview Study" prepared for Energy, Mines and Resources Canada).

.8 Manpower and Equipment Availability

(a) Manpower

Employment and Immigration Canada indicates that the construction manpower availability for the construction period anticipated is in the order of 12 persons. (See Table 3.1). However, these figures may be inaccurate due to non-inclusion of those unemployed but not receiving unemployment insurance benefits.

TABLE 3.1

U.I.C. Recipients (15 Sept. 1983)

Conservation Officer	- 1	Nurse's Aide	- 3
Sheet Metal Worker	- 1	Secretary	- 1
Carpenter	- 1	Bookkeeper	- 1
Painter	- 1	Office Clerk	- 1
Labourers	- 9	Cook	- 1

Local opinion, however, indicates that as many as 15 labourers and 3 heavy equipment operators are typically available during the construction season.

.8 Manpower and Equipment Availability

(b) Equipment

The only heavy equipment in Mary's Harbour is a loader owned by Transport Canada and a small loader/backhoe which is privately owned. The Transport Canada equipment is assumed for their use only. The privately owned equipment may be utilized on a casual basis if and when available.

.9 Power Requirements

The communities of Mary's Harbour and Lodge Bay are served by a diesel generation plant located at Mary's Harbour. The plant consists of two 250 kilowatt generators and one 300 kilowatt generator, and serves the following customers:

Code	Classification	Number of Customers	Description
1.2	Domestic Diesel	139	Family units, churches, schools
2.2	10-100 kW	1	Fishplant
2.5	0- 10 kW	25	General stores, post office, airport, etc.
2.5	10-100 kW	2	Telephone exchange, hospital
5.06	Area Lighting	1	Street lights
		168	

The historic annual consumption for Mary's Harbour shows an average growth over tne past 2 to 3 years of around 5%. It was assumed for this study that this growth would continue for another five years and then drop off slightly for the remaining years. A growth of 3% was assumed from 1988 to 1993 and 2% was assumed for the remaining years.

.9 Power Requirements (cont'd.)

With the exception of domestic customers, the only new load predicted for the study period was the sewer system which is proposed to be installed in 1984. This load was added to the above projections to obtain the total annual sales forecast for the study period, as well, the annual kWh losses of approximately 7% was added to the annual kWh sales for each year to obtain the annual production forecast.

This forecast is snown in Appendix A and is shown in part as follows:

Year	Demand (MWh)	Peak Load (kW)
1985	1168	404
1990	1392	481
1995	1577	545
2000	1733	599
2005	1914	662
2010	2113	731
2015	2333	807

4 HYDROLOGY

.1 General

A brief study was undertaken to establish hydrologic parameters for each development. The sequence of monthly flows, inputs needed for flow regulation studies to determine average and firm flows, were tabulated for the years 1966 to 1982. This is the longest period that systematic flow records have been kept in the Southeastern Labrador area.

.2 Drainage Areas

The drainage area determined by planimetry from 1:50,000 scale maps is 473 square kilometers.

.3 Synthesis of Flow Records

Flow records were unavailable for St. Mary's River, therefore, it was necessary to synthesize monthly flows from the neighbouring gauged rivers.

- Eagle River (STA 03QC001) D.A. 10900 km^2
- Alexis River (STA 03QC002) D.A. 2310 km^2

Synthesis of flow records was on the basis of simple drainage area proration and is shown in Appendix B. The actual data used for the regulation study were the average flows from the Eagle River as these are compiled from a longer period of record than those of the Alexis River. Due to the short period of record, the synthesized flows from the Alexis record can only be used for comparison purposes.

As the Alexis River is physically closer to St. Mary's River and much smaller than the Eagle River, it was necessary to confirm that drainage area proration of the Eagle River to St. Mary's River was valid.

.3 Synthesis of Flow Records

Comparison of the synthesized flows from both gauged rivers shows very similar results, indicating that the same flow regime exists despite differences in their drainage area and geographical location. Since St. Mary's River drainage area is very close to that of the Alexis River, it can be assumed that the Eagle River synthesized flows for St. Mary's River are valid.

The following data was derived from the analysis to be applied to the catchment area.

Mean Annual Specific Runoff	0.0247 $m^3/s/km^2$
Ratio between Mean Annual Peak Flood Discharge and Mean Annual Flow	7.6
Ratio between the 1-in-100 year Flood Peak Discharge and Mean Annual Flood Discharge	2.2

For St. Mary's River the specific parameters adopted are summarized as follows:

Drainage Area	473 km^2
Mean Annual Flow	11.7 m^3/sec
1-in-100 Flood Peak Discharge	196 m^3/sec

5 GEOTECHNICAL CONSIDERATIONS

.1 Program of Investigation

The program of investigation consisted of a geologic surface observation carried out at all structure sites in November, 1983.

.2 Construction Materials

Preliminary investigation indicates that there are two small areas of borrow material. One small area on the southern side of the community of Mary's Harbour, contains a 1 meter veneer of fine till type material. The suitability of this material for most construction is very questionable. A second small area of till is located near the Grenfell Nursing Station. This material is located on Grenfell property and for their use only.

Further investigations will have to be carried out and if no natural deposits are found, concrete aggregates will be processed on site with the exception of sand which will be imported.

.3 Dam and Spillway

The proposed dam and spillway are located in a small north-south oriented valley. The shallow section of dam stretches over a very flat area with a 0.3 meter thick layer of organics overlying bedrock. In the remaining section, bedrock is exposed. The bedrock has very few fractures and thus will serve as an adequate foundation for the proposed structure.

.4 Fishway and Intake

The fishway and intake are to be constructed in the dam and spillway structure. Bedrock is covered by an approximate 0.3 meter layer of organics.

.5 Penstock

The penstock route extends 245 meters in a general west-east direction along the side slope of the valley. The pipeline will be in rock excavation which is covered with a layer of 0.3 to 0.4 meters of organic material.

.6 Powerhouse and Tailrace

Tne proposed powernouse site is located on the northwest side of the river. The river bank has a relatively gentle slope with approximately 0.5 meters of organics overlying bedrock. The tailrace excavation is mainly in bedrock.

.7 Access Roads

The approximately 1.3 kilometers of access road will be constructed over a relatively flat area with the exception of construction road for the penstock wnich will ascend the valley. No major problems of a geotechnical nature are expected to affect the road construction.

.8 Transmission Line

The approximately 1.1 kilometers of transmission line will be constructed in the same right of way as the access road. No major problems of a geotechnical nature are anticipated.

6 PROJECT DESCRIPTION

.1 General

The proposed development is located approximately 1.3 kilometer southwest of the community of Mary's Harbour on the St. Mary's River. The proposed scheme selected is defined by the following parameters:

Installed Capacity		280 kW
Number of Units		1
F.S.L.	Elevation	17.0 m
T.W.L. (Normal)	Elevation	6.0 m
Rated Flow		3.84 m^3/sec.

A general description of the principal features of the development is given below and shown on Drawings B1-3119-1, 2 and 3.

.2 Access Roads

A permanent access road is to be built from the community to the powerhouse. The 1.0 kilometer road is to be constructed over a relatively level topography and a relatively barren terrain. Construction of the road is to be a cut and fill process in rock material with rockfill being utilized from structure excavation as required. The road will have a 4 meter gravel driving surface with 100 millimeters of processed gravel topping.

A temporary access road is to be built from the powerhouse to the intake structure, approximately 0.3 kilometers long. Construction will be relatively straight forward with the road being built from excavated material from the penstock excavation.

.3 Dam and Spillway

The dam and spillway structure is located on the St. Mary's River approximately 1.3 kilometers southwest of the community of Mary's Harbour.

.3 Dam and Spillway (cont'd.)

The structure will be of reinforced concrete construction, doweled to a prepared bedrock base.

The total length of dam is 210 meters including 180 meters of overflow spillway. The remaining 30 meters incorporates the intake and fishway sections. 110 meters of the spillway section have a height of one meter or less and the maximum height of spillway above the river bottom is 4 meters. The 70 meter section of spillway spanning the existing river will be suppressed 200 millimeters to allow the mean annual stream flow to be spilled into the natural river channel.

The structure has a top elevation of 18.25 meters with the spillway sections having elevations of 17.0 meters in the natural river section, and 17.2 meters elsewhere.

Unwatering will be accomplished by excavating a diversion channel through the rock on the south side of the river. With construction of the dam above the existing water level, a cofferdam will be constructed to close off the remaining section of river so that the spillway section can be completed. After completion of these structures, the cofferdam will be removed.

.4 Fishway

The fishway structure is located on the north side of the dam and spillway. The structure will be a vertical slot fishway with 300 millimeter lifts. There will be 10 to 11 days required to bring fish over the 3 meter high dam. The fishway will be covered with steel grating. A 760 millimeter diameter pipe will be provided through the dam, and regulated by a 900 millimeter vertical slide gate, to allow flow compensation in the river section downstream of the fishway when necessary.

.5 Upstream Channel Improvements

The upstream channel improvements will consist of a 80 meter long, 5 meter wide channel excavated. Excavation will be entirely in rock.

.5 Upstream Channel Improvements (cont'd.)

Construction will be carried out by building a rockfill ramp out into the river, drilling through the ramp and into the rock to the required depth, blasting and removing the material. A rock plug will remain in place and will be removed after completion of the dam, spillway, fishway, and intake structures.

.6 Intake

The intake structure is located on the north side of the fishway. The structure is embedded in rock with the exception of the top 2 meters. The intake will consist of a standard bell mouth intake reduced to a 1.2 meter diameter penstock. The structure will be provided with a steel trashrack and timber stoplogs for emergency repairs. The structure will be of mass reinforced concrete construction.

Unwatering will be accomplisned by leaving a rock plug in the upstream channel and pumping out any surface runoff or seepage.

.7 Penstock

The penstock is located on the northern slope of the river and is oriented in a general west-east direction. The penstock is approximately 245 meters long and will be a completely buried 1.2 meters diameter fiberglass reinforced plastic pipe.

The penstock excavation will be completely in rock and will be provided with a minimum grade to minimize excavation. Excavated material will be used to construct an access road to allow placement of the pipe. After placement on a prepared gravel bed, the pipe will be backfilled with select granular material to 1 meter over the top of the pipe and then further backfilled to original grade maintaining a minimum of 1 meter of cover.

Anchor blocks will be provided on all major bends and side drainage will be provided where necessary.

The penstock will be of fiberglass reinforced plastic construction with double O-ring bell and spigot joints along its length. The end connections to steel thimbles will use a fiberglass splicing kit.

.7 Penstock (cont'd.)

The penstock will be provided with a 300 mm Tee connection and gate valve near the powerhouse to accommodate connections of the water main for the community water supply.

The penstock will be shipped in 12 meter sections and easily installed by a backhoe and come-a-longs.

Unwatering of this structure is not expected to be a problem as only surface runoff or ground water seepage is expected. This can be handled by standard pumping procedures where required.

.8 Powerhouse

(a) Arrangement

The powerhouse is located on the northwest side of St. Mary's River, approximately 0.3 kilometers east of the dam, spillway and intake structures. The powerhouse substructure consists of a reinforced concrete foundation, founded in rock. The nominal dimensions of the substructure is 5 meters long by 5 meters wide by 4 meters deep with a 3 meter extension on the downstream end. This extension is provided with wooden stoplogs to dewater the draft tube and space to remove turbine components.

(b) Turbine-Generator

The turbine-generator unit which is normally rated at 280 kW at the generator terminals is a vertical Francis type with a speed increaser.

The prefabricated powerhouse is constructed in two sections. The lower turbine compartment is a watertight chamber directly connected to the penstock. This compartment contains the turbine, wicket gates, control linkage, guide vanes and draft tube. There is no spiral case. The upper section contains the generator which is housed in an insulated heated steel shell, and is mounted on top of the turbine compartment. This compartment contains the generator, speed increaser, governor,

.8 Powerhouse (cont'd.)

(b) Turbine-Generator (cont'd.)

switchgear, and controls. A 1.2 meter diameter penstock isolating valve will be provided immediately outside the powerhouse.

The entire powerhouse is shipped assembled except for the generator and steel draft tube, which are installed after the powerhouse is installed on the foundation.

The powerhouse is 3 meters in diameter, 7 meters high and has a shipping weight of 22 tonnes.

The powerhouse unit will be shipped to Mary's Harbour, trucked to site on a flat bed trailer and offloaded by a mobile crane.

Unwatering will be accomplished by leaving a rock plug in the tailrace channel and pumping out any surface runoff or seepage.

.9 Tailrace

The tailrace will consist of a 30 meter long, 5 meter wide channel excavated in rock.

The tailrace excavation will be done by building a rockfill ramp out into the river, drilling through the ramp and into the rock to the required depth, blasting and removing the material. Excavation of the rock plug will be completed after the draft tube stoplogs are installed.

7 WATER AND SEWER SYSTEM

.1 General

The water and sewer system for Mary's Harbour, consists of the construction of a water supply dam, intake, (shown on Drawing C-366-1-C11) storage tank, pumping station, water treatment plant, sewage outfall, and associated water and sewer mains and services. The construction of these facilities will be accomplished in three phases starting with Phase I in early 1984 and Phase II in early 1985.

.2 Phase I

Phase I consists of the installation of water and sewer mains and services along Main Street from the intersection of the water supply transmission main with the distribution main on Main Street to the sewage outfall at the harbour mouth.

.3 Phase II

Phase II consists of the construction of a dam and intake system, and a water supply transmission main from the dam to the intersection with Main Street, water and sewer mains and services from the intersection of the water supply main at Main Street to the R.C.M.P. Building, water and sewer mains and services on Barney's Pond Road, and the booster pumping station and water treatment.

.4 Phase III

Phase III consists of construction of water and sewer mains and services in the Muddy Cove area as well as the water storage tank and associated piping.

8 COMMON FACILITIES

.1 General

The two projects, described in section 6 and 7, if completed together have certain facilities considered to be common. These are as follows:

(a) Road

(b) Dam

(c) Intake

(d) Fishway

(e) Pipeline

.2 Road

In order to construct the dam and intake structures both projects require an access road for permanent access.

Although both projects require roads of equal standards, the road associated with the water supply will be easier to build, as construction will coincide with that of the water main. Installation of the water main will, in effect, result in a rough subgrade over which a topping will be placed. The hydro project road will require complete subgrade construction over which a topping will be placed.

.3 Dam

Both projects require a dam structure, but the requirements are substantially different.

(a) Water Supply Dam

The structure will have a crest elevation of 14.5 meters, a maximum height of 1.5 meters and a total length of 55 meters containing 50 cubic meters of concrete. For the low flows required for the water supply, minimal storage is required which results in a minimal dam structure.

.3 Dam (cont'd.)

(b) Hydro Project Dam

The structure will have a crest elevation of 17.0 meters, a maximum height of 4 meters and a total length of 210 meters containing 500 cubic meters of concrete. The large diameter penstock (1.2 meters) along with the high pipe flow require a deep submergance to allow efficient plant usage especially during winter freeze-up. To accomplish this a relatively large dam is required.

.4 Intake

Both projects require intake structures but due to the pipe diameters, flow requirements and submergance, are very different in size. The water supply requires a structure containing a 0.3 meter pipe intake while the Hydro project requires a structure containing a 1.2 meter pipe intake.

.5 Fishway

As both projects require dams, fisheries considerations require fish passage over the structures. Both projects require the same design of fishway but of different heights. The water supply dam requires a fishway height of 0.6 meters while the Hydro project requires a height of 3 meters. In both cases the fishways must be constructed in 0.3 meter steps.

.6 Pipeline

From the location of the Hydro project powerhouse to the dam, both projects require a pipeline. The Hydro pipeline consists of a buried 1.2 meter diameter pipe (penstock) whereas the water supply requires a buried 0.3 meter diameter pipe (water main).

9 CAPACITY AND ENERGY

The objective of this aspect of the study was to provide the following for the proposed mini-hydro development.

- Nominal Installed Capacity
- Average Annual Energy for each year from 1985 to 2015.

Flow duration data was derived from monthly average flows. To establish a nominal installed capacity at each site, a turbine flow was selected which is equalled or exceeded slightly more than 15 percent of the time. This flow equated to approximately 1000 kW which is well in excess of the power requirements of the community.

The unit selection then becomes a matching of unit size to load requirements. The long term projected average load in the year 2015 (30 years) is in the order of 270 kW. Inquiries with turbine manufacturers indicate that the most economical standard unit is a 280 kW unit which matches closely with the existing diesel units (2 @ 250 kW and 1 @ 300 kW) so that system operation would not be drastically altered.

Use of a larger unit was considered; however, review of flow data indicates that the increased energy would be small in comparsion to the increase in capital cost. During the five (5) month period when loads are high (Dec. - April) all available water is used, while during the remaining months the loads are relatively low such that increased unit size will not realize any sufficient additional energy increase (energy increase would be restricted to peak load periods of short durations). Further, during the summer period (July - Oct.) increase in water consumption will be restricted by fish compensation water requirements.

Investigation of the reservoir storage volume indicates that the scheme must be operated as a run of the river plant. The reservoir volume from full service level to low service level will maintain rated turbine flow for only a few hours during the period of lowest inflows. At most other times the inflow far exceeds the plant flow such that storage is of little or no importance. Long term or large storage at this site is deemed impractical.

The energy was then calculated based on the 280 kW unit which has a rated flow of 3.84 cubic meters per second.

9 CAPACITY AND ENERGY (cont'd.)

Allowances were made in the energy study to compensate for water usage and energy usage. The effect of poor water utilization due to flow fluctuations and small headpond reservoirs was compensated for to some degree by the use of a "Flow Use Factor." This factor is taken from a chart shown in Appendix G which was derived in "Study of Small Scale Hydro for Newfoundland and Labrador" by ShawMont Newfoundland Limited (SM-2-79). The fluctuation in energy usage was compensated for by using projected peak loads and load factors supplied by the Power Distribution District of Newfoundland and Labrador Hydro. The projected peak loads are tabulated in Appendix D. The effect of load fluctuation was compensated for to some degree by the use of a "Load Use Factor." This factor is taken from a chart shown in Appendix G which was derived in "Study of Small Scale Hydro for Newfoundland and Labrador" by ShawMont Newfoundland Limited (SM-2-79).

The net head used for each development is derived from field survey information and by using standard engineering formula to compute head losses. The computed gross head for the proposed scheme is 11.0 meters. Calculations show an average head loss for the 1.2 meter diameter penstock to be 1.1 meters, leaving an average net head of 9.9 meters.

The adopted parameters for the energy calculations are as follows:

Mean Annual Stream Flow	11.70 m^3/s
Average Net Head	9.9 m
Efficiency (Turbine and Generator)	0.75
Rated Turbine Flow	3.84 m^3/s
Nominal Installed Capacity	280.0 kW

9 CAPACITY AND ENERGY (cont'd.)

The usable energy output of the development (see Appendix C) is summarized below.

Year	Total Forecast (MWH)	Hydro (MWH)	Diesel (MWH)
1986	1223	1063	160
1987	1284	1103	181
1988	1318	1124	194
1989	1353	1146	207
1990	1392	1168	224
1991	1435	1194	241
1992	1474	1216	258
1993	1516	1236	280
1994	1546	1248	298
1995	1577	1263	314
1996	1605	1276	329
1997	1638	1288	350
1998	1668	1298	370
1999	1700	1309	391
2000	1733	1319	414
2001	1768	1333	435
2002	1805	1344	461
2003	1839	1356	483
2004	1876	1369	507
2005	1914	1382	532
2006	1951	1395	556
2007	1989	1406	583
2008	2029	1417	612
2009	2070	1430	640
2010	2113	1443	670
2011	2154	1457	697
2012	2197	1470	727
2013	2240	1484	756
2014	2287	1500	787
2015	2333	1515	818
Maximum	Unlimited	1893	-
Max. Firm	Unlimited	1580	-

10 ENGINEERING AND CONSTRUCTION SCHEDULE

.1 Construction Methodology

The schedule of engineering and construction activities, shown on the construction schedule - Figure 10.1 - indicates completion by December, 1985. This is based on a project release of May 1, 1984. The project will be constructed in five months. Construction of the dam is scheduled in two phases because of the salmon run between mid-July and late August and trout which extends into September.

The first phase will consist of completing the shallow section of dam on the south bank of the river and the section of dam around the fishway and intake structures on the north bank of the river, which for the most part, are presently in the dry, and do not limit fish migration. A diversion channel will be excavated on the south bank of the river at the same time. This work will be completed between mid June, 1985, and late August, 1985.

The second phase will consist of completing the dam across the main river flow section. This will include building a cofferdam from the north shore to the new south dam section, and diverting the water through the new diversion channel. After completion of the middle section of dam, concrete stop logs will be positioned across the diversion channel to complete the structure. This work will be completed between early September, 1985 and late October, 1985.

In order to achieve completion of the development on schedule, it will be necessary to construct the main civil works in accordance with the following schedules:

- Access from the community of Mary's Harbour to the powerhouse - mid June, 1985 to mid September, 1985.
- Access from powerhouse to dam - mid June, 1985 to mid July, 1985.
- Intake and upstream channel improvements - early August, 1985 to mid September, 1985.
- Fishway - mid August 1985 to late October, 1985.
- Penstock, including excavation for intake and powerhouse - mid June, 1985 to late October, 1985.

MARY'S HARBOUR MINI-HYDRO - CONSTRUCTION SCHEDULE

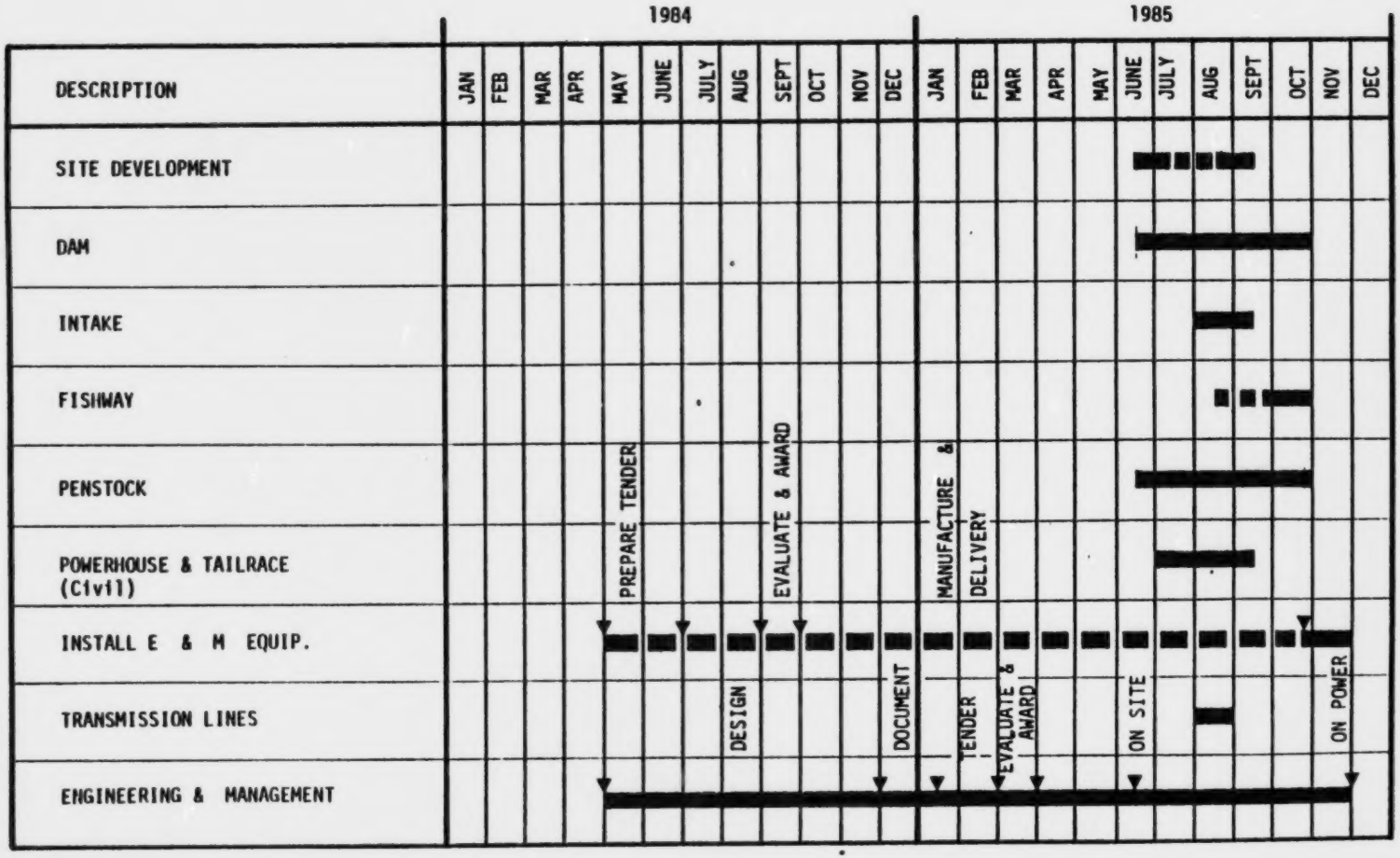


Figure 10.1

.1 Construction Methodology (cont'd.)

- Powerhouse and tailrace (civil) - early July, 1985 to mid September, 1985.
- Powerhouse (electrical and mechanical) - mid September, 1985 to late November, 1985.
- Transmission line and substation - late July, 1985 to late August, 1985.

.2 Contract Packages

The construction schedule for this development includes two major supply packages and two work packages.

(a) Contract 1

Contract 1 includes the design, supply and erection supervision of the turbine-generator unit. The unit is complete with, but not limited to turbine, generator, wicket gates, control linkage, draft tube, speed increaser, governor, and prefabricated powerhouse. The value of this contract is approximately $320,000.

(b) Contract 2

Contract 2 includes the design, supply and erection supervision, if required, for the fibreglass reinforced plastic penstock. The value of this contract is approximately $115,000.

(c) Contract 3

Contract 3 includes all the civil work to be done on site, as well as any associated mechanical and electrical work required. The civil works includes but is not limited to the construction of access roads, excavation and concrete works at the dam, fishway, intake, penstock and powerhouse areas, installation of penstock, and erection of turbine-generator. The total value of this contract is approximately $1,250,000.

.2 Contract Packages

(d) Contract 4

Contract 4 includes all tne civil and electrical work required for the installation of a transmission line and substation. Work will include both underground and overhead transmission lines. The value of this contract is approximately $90,000.

.3 Turbine-Generator Package

The early start of October 1, 1984 on the turbine-generator contract is essential to meet the on-power date of November, 1985. A twelve month manufacture and delivery period is required.

.4 Penstock

Tenders for the supply of the penstock will be called and awarded by early June, 1985, with delivery to site by mid August, 1985, for installation.

.5 Civil Works

The contract for the civil works will be awarded by April 1, 1985. Construction of tne dam, penstock excavation and access road will be started by mid June. Access to site will be by track machines until the road is completed in mid September, 1985. Tne dam, fishway, intake, penstock and powerhouse will be completed by late October, 1985.

.6 Construction Accommodations

The construction of the Mary's Harbour Mini-Hydro project will not require a construction camp. With the workforce requirement on an average of 30 persons, approximately half of which may be from the community, adequate accommodation should be available for the remaining workforce in boarding houses.

.7 Construction Power

Construction power at each structure site will be by portable diesel power plants and will be the responsibility of the contractor. Power at the powerhouse site will be by diesel up until early September, when the transmission line from Mary's Harbour will be completed. This line will supply power to the powerhouse only.

.8 Manpower and Equipment

(a) Manpower

It is estimated that the following manpower will be required to complete the project on schedule:

Month	June	July	Aug.	Sept.	Oct.	Nov.
Supervisory	3	5	5	5	5	5
Operations	5	6	6	6	3	-
Carpenters	-	6	6	6	6	-
Labourers	2	13	13	13	11	-
Total	10	30	30	30	25	5

Local opinion indicates that the manpower availability in Mary's Harbour is in the order of 15 labourers and 3 operators during the construction season. This indicates that only skilled labour will have to be brought in by the contractor. Employment and manpower figures (See Table 3.1) indicate a lower manpower availability for that time of year but these figures may be inaccurate due to non-inclusions of those unemployed but not receiving unemployment insurance benefits.

.8 Manpower and Equipment (cont'd.)

(b) Equipment

It is estimated that the following equipment will be required to complete the project on schedule:

1 - Air Trac w/compressor

1 - 3.5 m^3 Front End Loader

1 - 105 kw Crawler Tractor

1 - 1 m^3 Hydraulic Crawler Backhoe

1 - 1 m^3 Front End Loader w/backhoe

2 - 8 m^3 Tandem Dump Trucks

1 - 1 m^3 Cement Mixer/Batch Plant

Miscellaneous small equipment (pumps, generator, etc.)

The only available equipment in Mary's Harbour is a privately owned small loader/backhoe. Although this piece of equipment may be utilized, it cannot be considered available for the duration of the project. Due to the tight construction schedule, sharing of equipment with other contractors which may be in the area, such as the water supply contractor, does not seem practical, therefore, the project contractor will have to import all necessary equipment.

11 CAPITAL COST ESTIMATE

.1 General

The preparation of the capital cost estimates involved the computation of quantities from drawing layouts and sketches prepared from centre-line profiles and 1:2500 mapping. The cost estimate is prepared in mid 1983 dollars.

The proposed development was broken down into the following component packages for estimating purposes.

- Site Development
- Dam
- Fishway
- Intake
- Penstock
- Powerhouse and Tailrace
- Electrical and Mechanical Equipment
- Transmission Line and Substation

.2 Costs

Hydro's experience with similar projects in Newfoundland, was used in completion of the estimate. Budget quotations for the necessary construction materials were obtained from Newfoundland suppliers where possible. In addition, budget prices were obtained for the various types of turbines (including generator and control package).

Estimating procedures were based on the following assumptions.

(a) Labour

Manpower availability is limited in Mary's Harbour with approximately one-half of the normal labour force for such a project (30 persons) being locally available. Manpower would be

.2 Costs (cont'd.)

(a) Labour (cont'd.)

hired through the general contractor. It is assumed that adequate housing (boarding houses) is available to accommodate the necessary outside personnel.

(b) Equipment

Adequate construction equipment will not be available for rent in the Mary's Harbour area; therefore, all construction equipment will be shipped into Mary's Harbour and will be contractor-supplied and operated.

(c) Materials

Most materials required for construction of the structures will be available in Newfoundland. All construction materials, with the exception of aggregates will have to be brought into Mary's Harbour. Aggregates will be processed from blasted rock.

(d) Hydro Equipment Package

A contract package would be necessary for the hydraulic turbine/generator/control equipment.

.3 Contingency

Contingency is the estimated allowance judged necessary to successfully undertake, manage and complete the project within a fixed time and cost estimate. It is the aggregate of a number of variables including the extent of field investigative work and engineering refinement, logistic factors, the sensitivity of construction, manufacturing and labour markets and the effect of regulatory agencies such as environment, climatic and field conditions encountered.

Due to the availability of engineering survey data and good confinence in structure location a relatively low allowance (10%) has been used.

.4 Engineering and Construction Management

An allowance for the cost of engineering, investigations, surveys, planning, procurement and construction management has been estimated as if design and construction supervision was carried out by Newfoundland and Labrador Hydro.

.5 Escalation, Interest During Construction and Corporate Overheads

(a) Escalation

Escalation is the cost included to anticipate the effect of future inflation on the forecast final cost of the project.

The escalation associated with the Capital Cost Estimate is developed by compounding the projected rates of inflation from the Project Base Date to the original scheduled fabrication/installation of the work items in the project.

Escalation was included at the following rates:

1983 - 84	-	6.79%
1984 - 85	-	7.86%

(b) Interest During Construction

Interest During Construction is an estimate of the Corporation's projected average cost of borrowing for the term of the project. A monthly rate is applied to the accumulated cash flow for the previous period plus one half the cash flow for the current period. The interest charge is included in the accumulated cash flow and is calculated on the basis of cash-out cash flow from the time of the first disbursement to first commercial operation.

Interest During Construction was included at the following rates:

1983	-	13.50%
1984	-	13.50%

.5 Escalation, Interest During Construction and orporate Overheads (cont'd.)

(c) Corporate Overheads

Corporate Overhead is a percentage levy applied against Projects to recover a proportionate share of corporate costs not specifically identified, (e.g. executive payroll, systems planning, support services and other administrative and financing costs).

Corporate Overhead for this type of project was included at 4.5%.

.6 Common Facilities

The aspects of tne mini-nydro development tnat were considered common to tne water supply system are:

(a) Road from community

(b) Dam

(c) Intake

(d) Fishway

(e) Section of water main from powerhouse to dam.

Direct costs for each of these aspects were obtained from Sheppard, Hedges and Green Limited, the designers of the water supply system, and are as follows:

Road	$ 62,000
Dam	$ 90,000
Intake	$ 44,000
Fishway	$ 30,000
Pipeline	$ 120,000
	$ 346,000

.7 Capital Cost Estimate Summary

The capital cost estimate for the mini-hydro development, if built independently of the water supply project, is $3,024,000, as detailed in Table 11.1.

.7 Capital Cost Estimate Summary (cont'd.)

The capital cost estimate for the same project, realizing the common facilities as outlined above shows a total saving of $570,000 for a total of $2,454,000, as detailed in Table 11.2.

The cost and cash flow estimates are included in Appendix E.

TABLE 11.1

CAPITAL COST ESTIMATE SUMMARY: PROJECT WITHOUT COMMON FACILITIES

Base Cost: Mid 1983

1.	Site Development	$ 129,000
2.	Dam	587,000
3.	Fishway	160,000
4.	Intake	101,000
5.	Penstock	257,000
6.	Powerhouse and Tailrace	98,000
7.	Electrical and Mechanical	375,000
8.	Transmission and Substation	150,000
Total Direct Cost		$1,857,000
Engineering and Construction Management		334,000
Corporate Overheads		99,000
Contingency		229,000
Sub-Total		$2,519,000
Escalation		408,000
Interest During Construction		97,000
TOTAL PROJECT COST		$3,024,000

TABLE 11.2

CAPITAL COST ESTIMATE SUMMARY: PROJECT WITH COMMON FACILITIES

Base Cost: Mid 1983

1.	Site Development	67,000
2.	Dam	497,000
3.	Fishway	130,000
4.	Intake	57,000
5.	Penstock	137,000
6.	Powerhouse and Tailrace	98,000
7.	Electrical and Mechanical	375,000
8.	Transmission and Substation	150,000
Total Direct Cost		$1,511,000
Engineering and Construction Management		272,000
Corporate Overneads		80,000
Contingency		187,000
Sub-Total		$2,050,000
Escalation		332,000
Interest During Construction		72,000
TOTAL PROJECT COST		$2,454,000

12 PROGRAM OF ONGOING STUDIES

.1 General

Several studies and investigations are required in the early stages of the next phase of engineering to firm up the project and to provide sufficient data for detailed final design and data for tenderers.

.2 Geotechnical Investigations

A geotechnical program should be implemented in early summer of 1984. The program objectives should be to obtain information from boreholes, rock probes and test pits at structure sites.

.3 Field Surveys

Profiles and cross-sections should be completed for final design and layout of all civil works. Underwater contours of the tailrace entry to St. Mary's River and the intake area will also be required.

.4 Facilities

Further design of the penstock alignment and grades should be done based on the field information from above. Based on the final alignment and grades further design of the penstock will be necessary to optimize penstock material, diameters and wall thicknesses. The structure locations and arrangements need further design based on the further geotechnical investigations to firm up foundation conditions.

.5 Hydrology

A review of hydrology and an optimization of power output should be carried out by further regulation studies to firm up the unit size and available energy.

.6 Ice Studies

A field program should be commenced to collect water temperature data and other data relating to the formation of ice in the intake area and tailrace. The data and the thermal regime of rivers and lakes in the project area should be analyzed to establish ice related criteria for the project. The potential for frazil ice production should also be investigated.

.7 Flood Study

The steady into which the tailrace exits should be studied relative to maximum flood level, particularly due to ice jams as this affects the powerhouse floor elevation.

13 ENVIRONMENTAL CONSIDERATIONS

The following is a summary of the Environmental overview in Appendix F:

The purpose of this section of the study is to review the resource conflicts associated with the proposed St. Mary's River mini-hydro development, which is located approximately one km west of the coastal community of Mary's Harbour in southern Labrador.

The project involves the construction of a concrete dam across the St. Mary's River, three meters in heignt, creating a reservoir 5.66 ha in area. The project also involves the construction of a 280 kW powerhouse and assoicated penstock and intake, and provision of an access road and a tranmission line, both 1.1 km in length.

The most significant biotic resource in the proposed development area is fisn, with three anadramous salmonid species using the river. It has been estimated on the basis of available nabitat, that this river could sustain a population of 2,700 - 4,000 Atlantic Salmon. It has been speculated that anadramous brook trout populations may be three times as great. Arctic char populations are relatively insignificant. While there is little or no spawning or rearing habitat downstream of the proposed project, these species must migrate upstream annually to spawn in the basin's headwaters. Atlantic salmon run between July 15 and August 31, while trout and char run between August 15 and September 30. Adults overwinter in lakes and pools upstream, migrating downstream with the smolt run in May and June.

The human environment has been given limited consideration, with no investigation of present socio-economic conditions. Although there are no known sites, there is some potential for archaeological sites in the area. Recreational use of the proposed development area is relatively intensive.

Apart from the potential impacts on fish, the proposed development does not pose any serious environmental impacts. There will be a loss of 3.11 ha of land to flooding, and a furtner 2.0 ha to civil works and construction. There may be some minor habitat loss for small mammals, and

13 ENVIRONMENTAL CONSIDERATIONS (cont'd.)

some minimal impact of construction activities on migratory birds. There is potential for some impact on historic resources. There may be some negative effects on the recreational use of the area, although in fact, the development may present some positive impacts.

The major potential impact is the effect of the proposed development on the migration of anadramous salmonids. The construction of the dam, if unmitigated, would effectively block upstream migration and might impede downstream movement of kelts and smolt. As a consequence, a fish ladder has been incorporated in the design.

While the flow requirements of the powerhouse will be less than average existing flows from May through December, on average, there will be no flow between the dam and powerhouse from January through April. Thus, this section of the river will experience reduced flows throughout the year, and will be, on average, dewatered throughout the winter months. However, the impact of this altered flow regime is expected to be minimal on fish populations as it has been shown that even during dry years, there will be sufficient water to permit migration upstream to the dam and through the fish ladder.

Other potential impacts of the development on fish populations have been identified. There may be a problem with smolt entrainment into the intake structure during their seaward migration. The tailrace may provide an attractive diversion to upstream migrating fish. The creation of a fish ladder may result in increased poaching.

While some impacts of the proposed development are non-mitigatible, the following mitigation is proposed.

.1 For the aesthetic ennancement of the future reservoir, it will be cleared of all trees to a height of one meter above full supply level (14 - 18 m F.S.L.).

.2 A vertical slot fish ladder will be constructed between the top of the north side channel over the crest of the dam. Pools will be 1.5 meters deep and 1.8 x 2.4 meters in dimension. There will be a pool

13 ENVIRONMENTAL CONSIDERATIONS (cont'd.)

.2 (cont'd.)

1.5 meters deep below the first ladder pool. The ladder will rise in 0.3 meters increments. It will be necessary to provide a minimum fish ladder maintenance flow of 0.43 to 0.57 m^3/sec. It may be necessary to release additional flow into the bottom pool to supplement flows below the ladder in the natural north side channels. This will require detailed investigation of natural flows in the north side channel during fish migration.

.3 To prevent poaching, the ladder will be covered with a metal grating. This may also be required in the natural north side channel.

.4 The intake will be screened during May and June to prevent smolt entrainment.

.5 A post-development monitoring study will be required to demonstrate that the mitigation to provide fish passage has been successful.

.6 An archaeological field reconnaissance will be carried out, with a contingency for further work if necessary.

.7 Hydro will implement sound environmental construction practices.

(a) Clearing will be limited to that which is absolutely necessary. The picnic area will retain a tree screen and buffer zone.

(b) The upstream migration of fish must not be impeded between July 15 and September 15. It may be necessary to cease instream work during the last week of July and the first week of August.

This project will be registered under the Environmental Assessment Act as soon as it is approved. It is anticipated that, given the proposed mitigation, the project will be allowed to proceed without an Environmental Preview Report or Environmental Impact Statement.

14 COST EFFECTIVENESS ANALYSIS

.1 Metnodology

(a) General

The general method used to compare the cost-effectiveness of a generation expansion alternative is to compare on a present worth basis, incremental investment and system operating costs for alternative system expansion. For a particular discount rate, tne preferred alternative is the one with the lowest present worth cost.

The two alternatives under consideration are:

- the existing Mary's Harbour diesel plant consisting of 800 kW installed.
- the addition of a 280 kW mini-hydro plant to the existing system in late 1985.

Both alternatives are costed using the same forecast for a period of 30 years, wnich represents the economic life of the mini-hydro scheme. This report presents the analysis from Newfoundland and Labrador Hydro's perspective. Capital costs used in the study are only HYDRO'S share of those costs which may or may not be reduced by outside funding and/or savings from common facilities.

Tnis analysis uses tnree methods for presenting results:

(1) the cumulative present worth cost of incremental investment and operating costs for each alternative.

(2) the cross-over date wnich is determined as tne date wnen the cumulative present worth of tne nigher capital cost project crosses below the cumulative present worth of tne alternative project.

(3) the benefit/cost ratio for the project.

.1 Methodology (cont'd.)

(a) General (cont'd.)

The latter method is calculated as follows:

$$\frac{\text{Benefit due to project}}{\text{Cost of project}} = \frac{(\text{PW Costs Alt. B} - \text{PW Costs Alt. A}) + \text{PW Cost Proj. A}}{\text{PW Cost Proj. A}}$$

where

PW Cost Alt. A = Cumulative present worth of investment and incremental operating costs for the alternative that includes Project A (i.e. Hydro-diesel alternative).

PW Cost Alt. B = Cumulative present worth of investment and incremental operating costs for the alternative with which Alternative A is being compared (i.e. diesel alternative).

PW Proj. A = Cumulative present worth of only those costs associated with Project A (i.e. for the mini-hydro project it includes the capital cost and operating cost).

(b) Sensitivity Analysis

Sensitivity cases on the following study parameters were prepared in order to determine their impact on the viability of the project:

(1) Municipal Affairs financial involvement in the scheme.

(2) Capital Cost.

(3) Firm capacity for the mini-hydro plant.

(4) Discount rate.

Item (3) above deserves further elaboration. Because of low winter flows and minimal storage, a mini-hydro scheme is normally assumed by HYDRO to have no firm capacity. It

.1 Methodology (cont'd.)

(b) Sensitivity Analysis (cont'd)

essentially functions as a fuel saver only. All future generation expansion based on the system's firm capacity meeting the load is common to both alternatives and can be excluded from the analysis. However, since the plant's rate flow (3.84 m^3/s) i.e., is much less than the stream's mean annual flow (11.7 m^3/s), a sensitivity case crediting the hydro plant with firm capacity was prepared. A value of 30 kW, which represents the minimum monthly average output during the firm flow sequence was chosen and future diesel plant expansions were included in the analysis and adjusted accordingly.

As a part of the analysis, an indication of the level of additional funding required to achieve a cross-over date of 5, 10 and 15 years for the mini-hydro alternative is determined using the following formula:

$$\text{Additional funding} = \frac{(\text{PW Costs, Hyd-Dsl Alt.} - \text{PW Cost Dsl Alt.})_{\text{year (n)}}}{\text{PW Factor}_{\text{year (p)}}}$$

where

PW Costs = Cumulative Present Worth Cost for the alternative.

year (n) = year in which cross-over is desired.

year (p) = year in which the project is capitalized (i.e. 1985).

PW Factor = $(1/1.13)^3$ = 0.6931 for 1985 (assuming 13% discount rate).

This gives the amount by which the project's total cost must be reduced in order to achieve the desired cross-over date.

To summarize, the following cases are presented:

Case 1 - diesel alternative versus the hydro-diesel alternative assuming future diesel plant expansion excluded, no Municipal Affairs involvement, base hydro capital cost and base discount rate.

Case 2 - as in Case 1 except one half of Municipal Affairs' maximum financial involvement (i.e., $285,000).

.1 Methodology (cont'd.)

(b) Sensitivity Analysis (cont'd)

Case 3 - as in Case 1 except maximum Municipal Affairs' financial involvement (i.e., $570,000).

Case 4 - as in Case 1 except 110% of base hydro capital cost.

Case 5 - as in Case 1 except future diesel plant expansion included and 30 kW firm capacity assumed for the mini-hydro plant.

Case 6 - as in Case 1 except 11% discount rate.

Case 7 - as in Case 1 except 15% discount rate.

.2 Economic Assumptions

(a) Discount Rate

The study is done in current dollars and assumes a base discount rate of 13%. Sensitivity cases for 11% and 15% were performed.

(b) Escalation

Individual escalation rates for various capital and operating costs were supplied by HYDRO'S Economic Analysis Department and are presented in Table 14.1.

(c) Fuel Prices

The 1982 average price per litre for diesel fuel used was based on actual operating costs at Mary's Harbour. Projections in Table 14.2 of fuel escalation were provided by HYDRO'S Economic Analysis Dept.

(d) Capital Cost

A total project cost of $3,024,000 was chosen as the base capital cost. Sensitivity cases for higher capital cost and various levels of Municipal Affairs financial involvement up to a maximum of $570,000 were carried out. An installed cost of

.2 Economic Assumptions (cont'd.)

(d) Capital Cost (cont'd.)

$681/kW (1984$) for a 300 kW diesel was used for future diesel additions in Case 5. This cost was pro-rated for additional capacity required to meet firm requirement during the forecast period.

(e) Forecast Load and Generation

The load forecast used in this analysis is listed in Table 14.3 and the generation split between hydro and diesel is as per the regulation study.

(f) Operation and Maintenance Cost

1982 actual operating costs for the Mary's Harbour diesel plant and the Roddickton mini-hydro plant were used to estimate fixed and variable O & M for the diesel plant and hydro plant respectively. The following table lists these costs and other operating data:

	O & M (1982$)	
	Diesel Alternative	Hydro-Diesel Alternative
Fixed	$99,120	$104,850
Variable	2.28¢/kWh	2.28¢/kWh(1)
Lube	2.13% of fuel cost	2.13% of fuel cost
Diesel efficiency	2.60 kWh/litre	2.60 kWh/litre

Notes:

(1) applied only to diesel generation.

These costs were escalated at the applicable rates from Table 14.1.

.3 Results of Analysis

Results are presented in Graphs 14.1 and 14.3 and are summarized in Table 14.4. Tables of detailed costs for each case are given in Appendix H.

Graph 14.1 and Table 14.4 indicate the following:

Case 1 - the hydro-diesel alternative is preferred by a present worth of $101.5 thousand at the end of the study period with a cross-over date of 2012 (after 27 years in service). The benefit cost ratio was calculated as 1.05. This case considers HYDRO proceeding with the project assuming no outside financial involvement. Under these assumptions, the project is just marginally cost effective.

Case 2 - the hydro-diesel alternative is preferred by $299.0 thousand at the end of the study period with a cross-over date of 2006 (after 21 years in service). The benefit cost ratio is 1.17. This case considers HYDRO and Municipal Affairs proceeding with a joint development resulting in a reduction in capital cost of $285 thousand. Some improvement in the project's viability over Case 1 is observed.

Case 3 - the hydro-diesel alternative is preferred by $496.5 thousand with a cross-over date of 2003 (after 18 years in service). The benefit cost ratio is 1.25. This case is similar to Case 2 except Municipal Affairs involvement is set at the maximum (i.e. $570 thousand). The project still, however, breaks even in the latter half of its life.

Case 4 - the diesel alternative is preferred by $108.1 thousand with no cross-over within the study period. The benefit cost ratio has dropped to 0.95. Because of the rather long break-even period (Case 1), a ten percent increase in capital costs makes the project uneconomic.

Graph 14.2 and Table 14.4 indicate the project's sensitivity to crediting the hydro plant with some capacity credit (30 kW). This results in delayed future additions in the expansion plan having the mini-hydro plant. The hydro diesel alternative was preferred by $120.7 thousand with a cross-over date of 2011. The benefit cost ratio is 1.06. This is a small improvement over Case 1.

.3 Results of Analysis (cont'd.)

Sensitivity to discount rate (case 6 and 7) is shown in Graph 14.3. For the general base case parameters the mini-hydro project is preferred for discount rates below approximately 13.5%.

For Case 1 to Case 5 an indication of additional funding required to improve the project's cost effectiveness in terms of the cross-over date is provided in Table 14.4.

.4 Conclusions and Recommendations

The results show that without additional funding in the form of a joint development or direct subsidy, the Mary's Harbour mini-hydro development is marginally cost-effective (i.e. cross-over occurs after 27 years). Under these conditions it is unlikely that Newfoundland and Labrador Hydro would proceed with the project. A projection of the level of additional funding required to improve the project's viability is between $767,000 and $2,079,000 based on the present estimate of capital cost. This, of course, includes savings because of the water and sewer project and funds from the Remote Community Demonstration Program.

With regard to the question of firm capacity credit for the mini-hydro plant, it would only be beneficial if the long term storage capability could be increased without incurring a substantial capital cost increase due to higher dam and fishway. Additional storage does not translate into significant fuel savings because the existing scheme of development satisfies a large proportion of load, especially in the early years.

In conclusion, the following items must be clarified before any commitment can be made by Hydro:

(1) an agreement with Municipal Affairs regarding the cost sharing of common facilities in a joint development must be reached.

(2) subject to preceeding item, the desired funding from the RCDP can be identified.

Table 14.1

Escalation Rates
(%)

Year	Diesel Plant	Operating & Maintenance
1983	2.35	6.35
1984	5.68	5.13
1985	5.63	5.89
1986	5.79	6.09
1987	6.09	6.60
1988	6.06	6.66
1989	5.52	5.61
1990	4.94	5.07
1991	4.78	4.95
1992	4.78	4.89
1993	4.90	5.20
1994	4.92	5.18
1995	5.04	5.45
1996	4.94	5.39
1997	5.24	5.24
1998	5.03	4.98
1999	5.00	5.09
2000-2015	5.13	5.21

Table 14.2

Projections of Fuel Escalation
(Distillate)

Year	Per cent Change
1983	6.16
1984	2.38
1985	6.24
1986	6.48
1987	8.87
1988	5.90
1989	6.84
1990	5.33
1991	5.72
1992	5.25
1993	5.94
1994	5.49
1995	6.23
1996	5.23
1997	5.32
1998	4.81
1999	5.19
2000-2015	4.93

Table 14.3

Load and Generation Forecast

Year	Load Forecast		Generation[1]	
	Peak kW	Energy MWhr.	Hydro MWhr.	Diesel MWhr.
1983	347	1003	-	1003
1984	369	1067	-	1067
1985	404	1168	-	1168
1986	423	1223	1063	160
1987	444	1284	1103	181
1988	456	1318	1124	194
1989	468	1353	1146	207
1990	481	1392	1168	224
1991	496	1435	1194	241
1992	510	1474	1216	258
1993	524	1516	1236	280
1994	534	1546	1248	298
1995	545	1577	1263	314
1996	555	1605	1276	329
1997	566	1638	1288	350
1998	577	1668	1298	370
1999	588	1700	1309	391
2000	599	1733	1319	414
2001	602	1768	1333	435
2002	624	1805	1344	461
2003	636	1839	1356	483
2004	649	1876	1369	507
2005	662	1914	1382	532
2006	675	1951	1395	556
2007	688	1989	1406	583
2008	702	2029	1417	612
2009	716	2070	1430	640
2010	731	2113	1443	670
2011	745	2154	1457	697
2012	760	2197	1470	727
2013	775	2240	1484	756
2014	791	2287	1500	787
2015	807	2333	1515	818

1. Assumes tne addition of a 280 kW nydro plant in the fall of 1985.

Table 14.4

Analysis Summary

Discount Rate = 13%

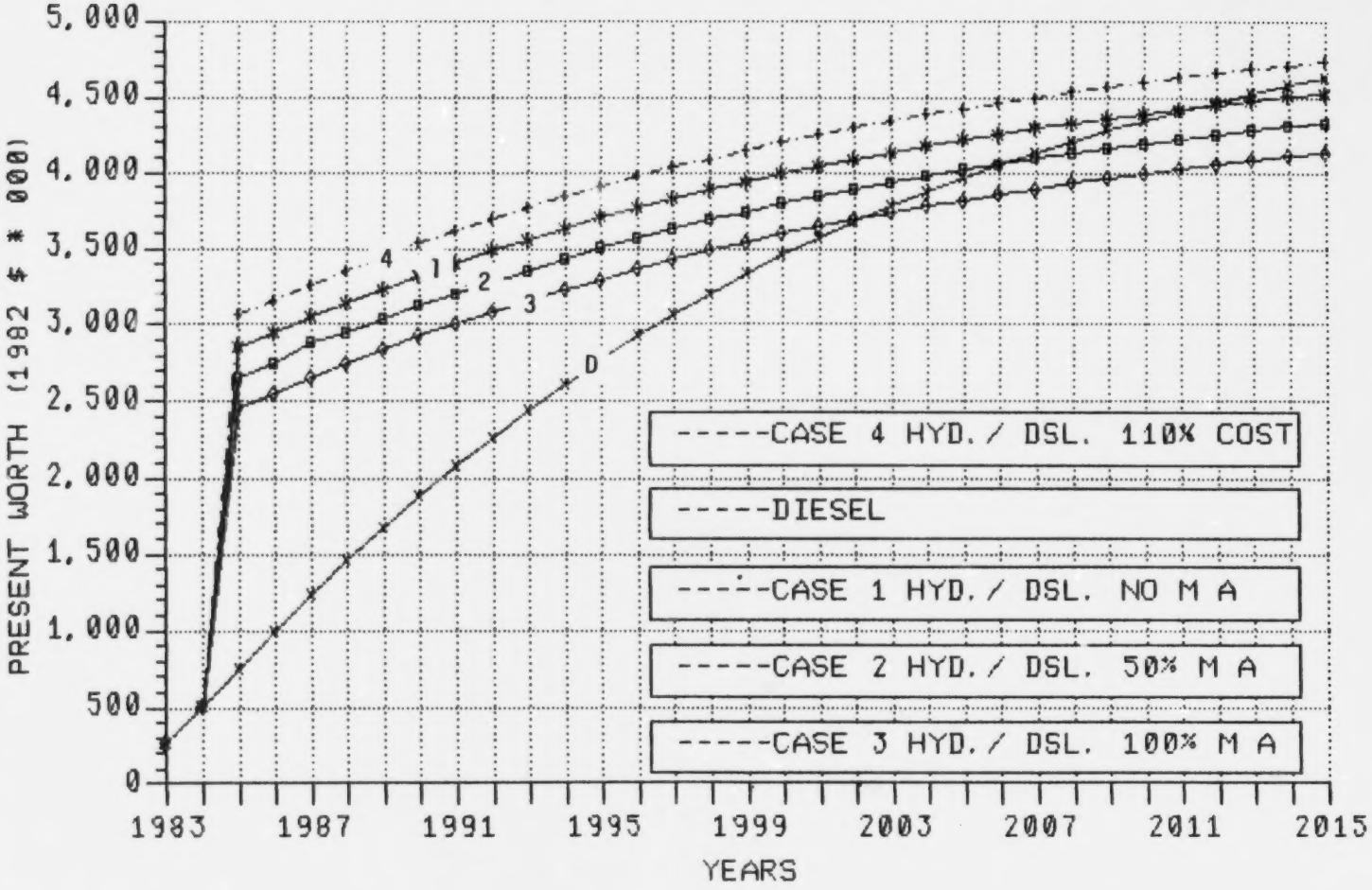
($X1000)

Case	PW Diesel[1] Alt. to 2015	PW Hydro-Diesel[1] Alt. to 2015	PW[1] Difference	B/C Ratio	Cross-over Date	Additional Funding[2] For Cross-Over in 5 yr	10 yr	15 yr
1.	4627.7	4526.2	101.5	1.05	2012	2079	1328	767
2.	4627.7	4328.7	299.0	1.17	2006	1794	1043	482
3.	4627.7	4131.2	496.5	1.25	2003	1509	758	197
4.	4627.7	4735.8	-(108.1)	0.95	-	2382	1631	1070
5.	4720.1	4599.4	120.7	1.06	2011	2079	1301	740

1. 1982$

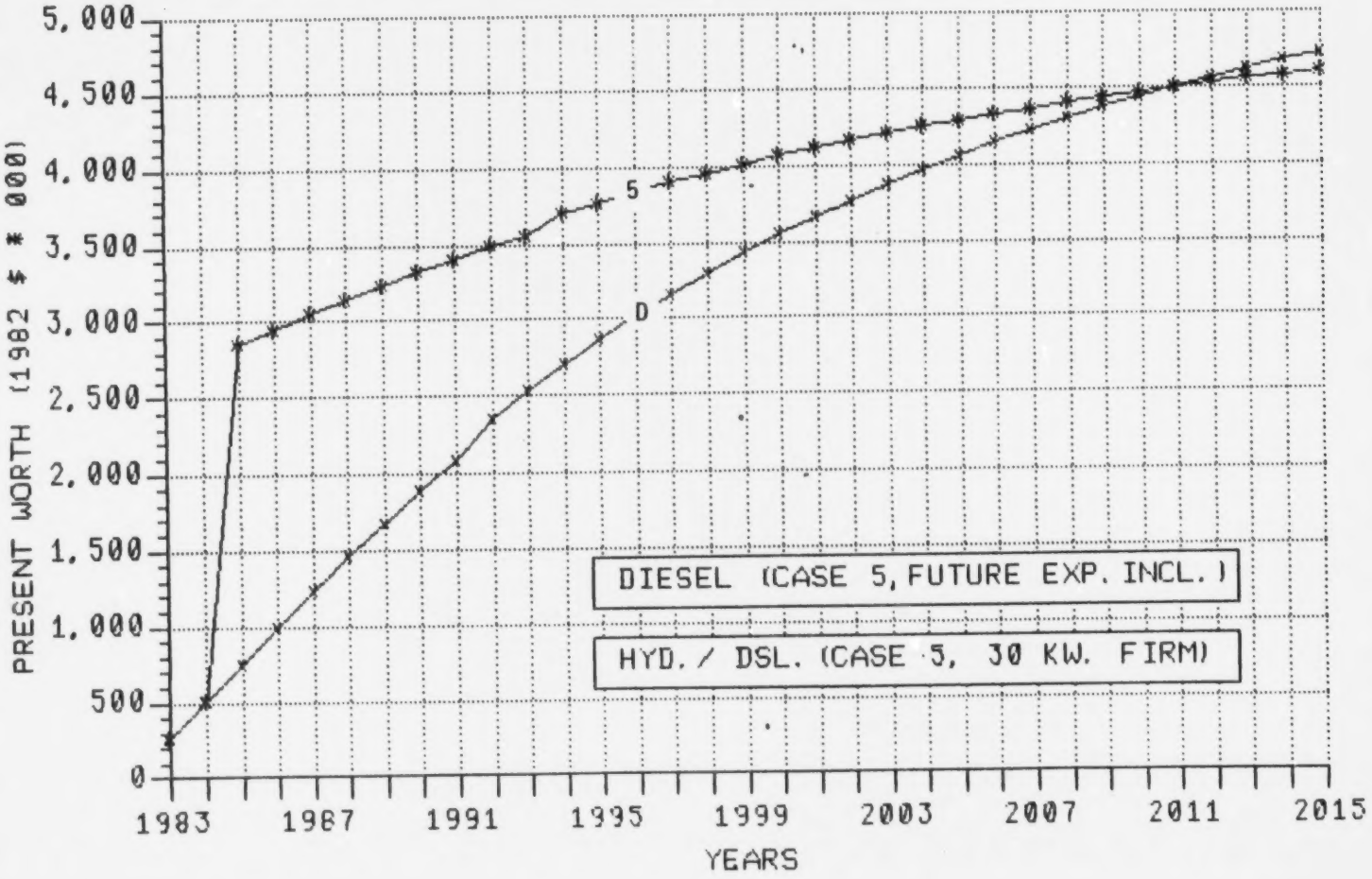
2. 1985$

CUMULATIVE PRESENT WORTH
MARYS HR MINI-HYDRO VS DIESEL



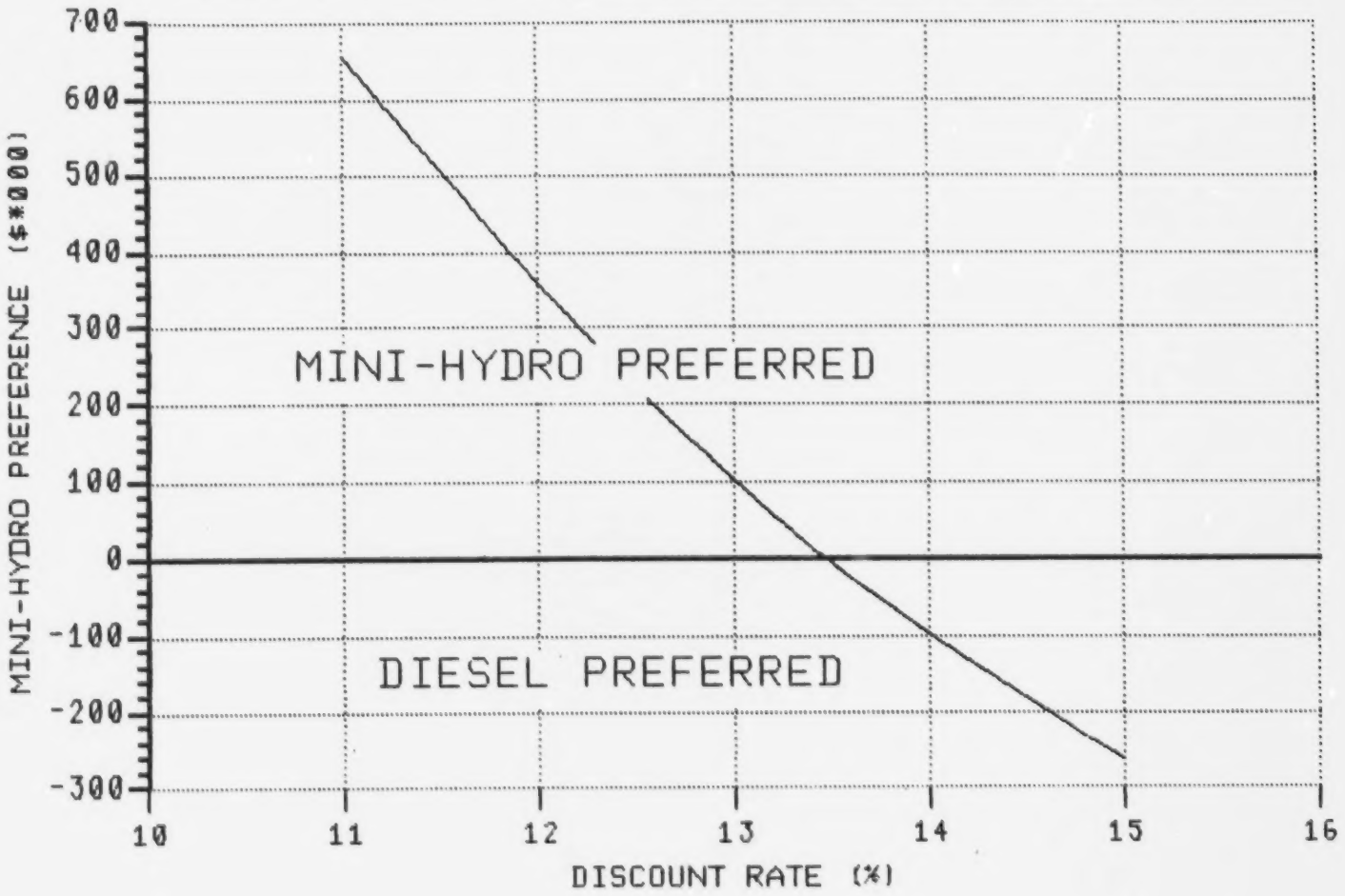
GRAPH 14.1

CUMULATIVE PRESENT WORTH
MARY'S HR. MINI-HYDRO VS. DIESEL



GRAPH 14.2

MARY'S HBR. MINI-HYDRO VS. DIESEL SENSITIVITY TO DISCOUNT RATE



GRAPH 14.3

APPENDIX A

- Peak Load Forecast

MARY'S HARBOUR - PEAK LOAD FORECAST
(Kilowatts)

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Peak
1984	338	346	338	338	251	200	200	215	292	323	361	369	369
1985	370	379	370	370	275	219	219	236	320	354	396	404	404
1986	387	396	387	387	288	229	229	247	335	370	414	423	423
1987	407	416	407	407	302	241	241	259	352	389	435	444	444
1988	418	427	418	418	310	247	247	266	361	399	446	456	456
1989	429	439	429	429	318	254	254	273	371	410	458	468	468
1990	441	451	441	441	327	261	261	280	381	421	471	481	481
1991	454	465	454	454	337	269	269	289	393	434	486	496	496
1992	467	478	467	467	347	276	276	297	404	446	499	510	510
1993	480	491	480	480	356	284	284	305	415	459	513	524	524
1994	489	500	489	489	363	289	289	311	423	467	523	534	534
1995	499	511	499	499	371	295	295	318	432	477	534	545	545
1996	508	520	508	508	377	301	301	324	440	486	543	555	555
1997	518	530	518	518	385	307	307	330	448	495	554	566	566
1998	529	541	529	529	392	313	313	336	457	505	565	577	577
1999	539	551	539	539	400	319	319	343	466	515	576	588	588
2000	549	561	549	549	407	325	325	349	474	524	586	599	599
2001	561	573	561	561	416	332	332	357	485	536	599	612	612
2002	572	585	572	572	424	338	338	364	494	546	611	624	624
2003	583	596	583	583	432	345	345	371	504	557	623	636	636
2004	594	608	594	594	441	352	352	378	514	568	635	649	649
2005	606	620	606	606	450	359	359	386	524	579	648	662	662
2006	618	632	618	618	459	366	366	394	535	591	661	675	675
2007	630	645	630	630	468	373	373	401	545	602	674	688	688
2008	643	658	643	643	477	380	380	409	556	614	687	702	702
2009	656	671	656	656	487	388	388	417	567	627	701	716	716
2010	670	685	670	670	497	396	396	426	579	640	716	731	731
2011	682	698	682	682	507	404	404	434	590	652	729	745	745
2012	696	712	696	696	517	412	412	443	602	665	744	760	760
2013	710	726	710	710	527	420	420	452	614	678	759	775	775
2014	725	741	725	725	538	429	429	461	626	692	774	791	791
2015	739	756	739	739	549	437	437	470	639	706	790	807	807
P.U. Peak	0.916	0.937	0.916	0.916	0.680	0.542	0.542	0.583	0.792	0.875	0.979	1.000	

APPENDIX B

- Eagle River MonthTy Flows
- Alexis River Monthly Flows
- St. Mary's River Synthesized Monthly Flows

EAGLE RIVER
Monthly and Annual Mean Discharges in Cubic Metres Per Second

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Mean
1966	--	--	--	--	--	--	--	--	--	435.0	255.0	105.0	--
1967	66.4	49.3	39.7	35.7	106.0	538.0	274.0	452.0	228.0	--	--	--	--
1968	--	--	--	--	--	--	--	--	--	348.0	266.0	125.0	--
1969	98.9	86.2	78.7	74.6	494.0	1180.0	360.0	207.0	133.0	232.0	226.0	144.0	276.2
1970	87.5	63.7	52.2	48.6	702.0	648.0	327.0	300.0	134.0	175.0	124.0	74.0	228.0
1971	53.6	43.2	37.2	197.0	1400.0	909.0	263.0	187.0	283.0	288.0	135.0	83.0	323.3
1972	45.4	31.2	24.1	20.7	273.0	1310.0	224.0	242.0	294.0	261.0	101.0	50.9	239.8
1973	36.9	29.8	26.5	32.8	1140.0	585.0	270.0	148.0	94.2	100.0	107.0	61.7	219.3
1974	43.0	34.4	29.6	29.0	454.0	1470.0	375.0	213.0	109.0	220.0	95.2	36.3	259.0
1975	22.4	17.2	14.3	12.4	276.0	813.0	263.0	201.0	291.0	170.0	117.0	62.8	188.3
1976	46.3	37.7	32.6	162.0	927.0	396.0	119.0	264.0	521.0	336.0	176.0	120.0	261.5
1977	63.2	44.3	37.3	64.4	739.0	1570.0	449.0	425.0	189.0	210.0	102.0	75.0	330.7
1978	54.7	43.8	35.9	47.2	517.0	1350.0	386.0	169.0	242.0	515.0	175.0	92.9	319.0
1979	68.1	69.1	69.0	--	--	337.0	288.0	333.0	292.0	290.0	194.0	67.0	--
1980	44.1	34.4	29.3	--	--	1010.0	533.0	339.0	187.0	333.0	352.0	143.0	--
1981	89.0	68.0	57.1	76.8	1260.0	1090.0	400.0	271.0	158.0	398.0	255.0	91.1	351.2
1982	57.7	43.8	35.7	34.7	324.0	1390.0	502.0	203.0	258.0	129.0	155.0	108.0	270.1
Mean	58.5	46.4	39.9	64.3	662.5	986.4	335.5	263.6	227.5	277.5	177.2	90.0	269.1

ST. MARY'S RIVER
Synsthesised Monthly and Annual Mean Discharges in Cubic Metres Per Second
Drainage Area Ratio = 0.04348

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Mean
1966	--	--	--	--	--	--	--	--	--	18.9	11.1	4.6	--
1967	2.9	2.1	1.7	1.5	4.6	23.3	11.9	19.6	9.9	--	--	--	--
1968	--	--	--	--	--	--	--	--	--	15.1	11.5	5.4	--
1969	4.3	3.7	3.4	3.2	21.4	51.2	15.6	9.0	5.8	10.1	9.8	6.2	12.0
1970	3.8	2.8	2.3	2.1	30.5	28.1	14.2	13.0	5.8	7.6	5.4	3.2	9.9
1971	2.3	1.9	1.6	8.5	60.8	39.5	11.4	8.1	12.3	12.5	5.9	3.6	14.0
1972	2.0	1.4	1.0	0.9	11.8	56.9	9.7	10.5	12.8	11.3	4.4	2.2	10.4
1973	1.6	1.3	1.2	1.4	49.5	25.4	11.7	6.4	4.1	4.3	4.6	2.7	9.5
1974	1.9	1.5	1.3	1.3	19.7	63.8	16.3	9.2	4.7	9.5	4.1	1.6	11.2
1975	1.0	0.7	0.6	0.5	12.0	35.3	11.4	8.7	12.6	7.4	5.1	2.7	8.2
1976	2.0	1.6	1.4	7.0	40.2	17.2	5.2	11.5	22.6	14.6	7.6	5.2	11.3
1977	2.7	1.9	1.6	2.8	32.1	68.1	19.5	18.4	8.2	9.1	4.4	3.3	14.4
1978	2.4	1.9	1.6	2.0	22.4	67.3	16.8	7.3	10.5	22.4	7.6	4.0	13.8
1979	3.0	3.0	3.0	--	--	14.6	12.5	14.5	12.7	12.6	8.4	2.9	--
1980	1.9	1.5	1.3	--	--	43.8	23.1	14.7	8.1	14.5	15.3	6.2	--
1981	3.9	3.0	2.5	3.3	54.7	47.3	17.4	11.8	6.9	17.3	11.1	4.0	15.2
1982	2.5	1.9	1.5	1.5	14.1	60.3	21.8	8.8	11.2	5.6	6.7	4.7	11.7
Mean	2.5	2.0	1.7	2.8	28.8	42.8	14.6	11.4	9.9	12.0	7.7	3.9	11.7

ALEXIS RIVER
Monthly and Annual Mean Discharges in Cubic Metres Per Second

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Mean
1978	9.7	7.3	6.2	10.6	188.0	160.0	41.2	33.6	49.1	75.1	19.8	12.8	51.1
1979	22.9	23.6	19.7	38.2	108.0	32.1	33.9	50.6	74.2	66.8	29.2	11.9	42.6
1980	7.8	5.8	5.2	26.5	246.0	208.0	64.6	38.4	38.1	72.0	103.0	30.7	70.5
1981	17.7	12.2	9.3	13.0	252.0	130.0	64.0	49.4	35.4	76.0	40.8	12.1	59.3
1982	7.8	6.4	5.8	6.4	172.0	164.0	88.9	39.9	32.2	24.6	44.8	19.7	51.0
Mean	13.2	11.1	9.2	18.9	193.2	138.8	58.5	42.4	45.8	62.9	47.5	17.4	54.9

ST. MARY'S RIVER
Synthesised Monthly and Annual Mean Discharges in Cubic Metres Per Second
(Drainage Area Ratio = 0.20480)

Year	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Mean
1978	2.0	1.5	1.3	2.2	38.5	32.8	8.4	6.9	10.1	15.4	4.1	2.6	10.5
1979	4.7	4.8	4.0	7.8	22.1	6.6	6.9	10.4	15.2	13.7	6.0	2.4	8.7
1980	1.6	1.2	1.1	5.4	50.4	42.6	13.2	7.9	7.8	14.7	21.1	6.3	14.4
1981	3.6	2.5	1.9	2.7	51.6	26.6	13.1	10.1	7.2	15.6	8.4	2.5	12.2
1982	1.6	1.3	1.2	1.3	35.2	33.6	18.2	8.2	6.6	5.0	9.2	4.0	10.5
Mean	2.7	2.3	1.9	3.9	39.6	28.4	12.0	8.7	9.4	12.9	9.7	3.6	11.2

APPENDIX C

- Regulation Study

MARY'S HR. MINI-HYDRO DEVELOPMENT

Year	Total Forecast (MWH)	Hydro MWH	Diesel MWH
1985	1168	1027	141
1986	1223	1063	160
1987	1284	1103	181
1988	1318	1124	194
1989	1353	1146	207
1990	1392	1168	224
1991	1435	1194	241
1992	1474	1216	258
1993	1516	1236	280
1994	1546	1248	298
1995	1577	1263	314
1996	1605	1276	329
1997	1638	1288	350
1998	1668	1298	370
1999	1700	1309	391
2000	1733	1319	414
2001	1768	1333	435
2002	1805	1344	461
2003	1839	1356	483
2004	1876	1369	507
2005	1914	1382	532
2006	1951	1395	556
2007	1989	1406	583
2008	2029	1417	612
2009	2070	1430	640
2010	2113	1443	670
2011	2154	1457	697
2012	2197	1470	727
2013	2240	1484	756
2014	2287	1500	787
2015	2333	1515	818
Maximum	Unlimited	1893	-
Max. Firm	Unlimited	1580	-

1984	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
N.FLOW	2.50	2.00	1.70	2.80	28.80	42.80	14.60	11.40	9.90	12.00	7.70	3.90	140.10
P.FLOW	1.59	1.40	1.19	1.54	1.52	1.13	1.21	1.15	1.52	1.86	2.08	1.80	17.99
P.SPILL	0.91	0.60	0.51	1.26	27.28	41.67	13.39	10.25	8.38	10.14	5.62	2.10	122.11
PK. LD.	338.00	346.00	338.00	338.00	251.00	200.00	200.00	215.00	292.00	323.00	361.00	369.00	
LD. FACT	0.44	0.42	0.40	0.39	0.44	0.41	0.44	0.39	0.38	0.42	0.42	0.39	
R.W.D.	0.82	1.00	1.09	0.65	0.05	0.03	0.08	0.10	0.15	0.16	0.27	0.51	
FL. FACT	0.78	0.70	0.70	0.85	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.91	
R.P.P	1.88	1.93	2.07	2.12	2.54	3.41	3.18	3.34	2.52	2.06	1.85	1.95	
L.U. FACT	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
POWER KW	115.80	101.88	86.88	112.27	110.44	82.00	88.00	83.85	110.96	135.66	151.62	131.20	1310.56
ENGY MWH	86.15	68.46	64.64	80.84	82.17	59.04	65.47	62.38	79.89	100.93	109.17	97.61	956.76

1985	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
N.FLOW	2.50	2.00	1.70	2.80	28.80	42.80	14.60	11.40	9.90	12.00	7.70	3.90	140.10
P.FLOW	1.67	1.40	1.20	1.64	1.66	1.23	1.32	1.26	1.67	2.04	2.28	1.93	19.30
P.SPILL	0.83	0.60	0.50	1.16	27.14	41.57	13.28	10.14	8.23	9.96	5.42	1.97	120.80
PK. LD.	370.00	379.00	370.00	370.00	275.00	219.00	219.00	236.00	320.00	354.00	396.00	404.00	
LD. FACT	0.44	0.42	0.40	0.39	0.44	0.41	0.44	0.39	0.38	0.42	0.42	0.39	
R.W.D.	0.89	1.09	1.20	0.71	0.06	0.03	0.09	0.11	0.17	0.17	0.30	0.55	
FL. FACT	0.75	0.70	0.70	0.83	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.89	
R.P.P	1.72	1.76	1.89	1.94	2.31	3.12	2.91	3.04	2.30	1.88	1.68	1.78	
L.U. FACT	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
POWER KW	121.36	102.22	87.11	119.12	121.00	89.79	96.36	92.04	121.60	148.68	166.32	140.40	1406.00
ENGY MWH	90.29	68.69	64.81	85.76	90.02	64.65	71.69	68.48	87.55	110.62	119.75	104.45	1026.78

1986	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
R.FLOW	2.50	2.00	1.70	2.80	28.80	42.80	14.60	11.40	9.90	12.00	7.70	3.90	140.10
P.FLOW	1.70	1.41	1.20	1.68	1.74	1.29	1.38	1.32	1.75	2.13	2.38	1.99	19.97
P.SPILL	0.80	0.59	0.50	1.12	27.06	41.51	13.22	10.08	8.15	9.87	5.32	1.91	120.13
PK. LD.	387.00	396.00	387.00	387.00	288.00	229.00	229.00	247.00	335.00	370.00	414.00	423.00	
LD. FACT	0.44	0.42	0.40	0.39	0.44	0.41	0.44	0.39	0.38	0.42	0.42	0.39	
R.W.D.	0.94	1.14	1.25	0.74	0.06	0.03	0.09	0.12	0.18	0.18	0.31	0.58	
FL. FACT	0.73	0.70	0.70	0.81	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.88	
R.P.P	1.64	1.68	1.81	1.86	2.21	2.98	2.78	2.91	2.20	1.80	1.61	1.70	
L.U. FACT	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
POWER KW	123.94	102.35	87.24	122.48	126.72	93.89	100.76	96.33	127.30	165.40	173.18	145.15	1454.74
ENGY KWH	92.21	68.78	64.90	88.19	94.28	67.60	74.97	71.67	91.66	115.62	124.69	107.99	1062.56

1987	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
R.FLOW	2.50	2.00	1.70	2.80	28.80	42.80	14.60	11.40	9.90	12.00	7.70	3.90	140.10
P.FLOW	1.74	1.41	1.20	1 73	1.82	1.36	1.46	1.39	1.84	2.24	2.48	2.06	20.72
P.SPILL	0.76	0.59	0.50	1.07	26.98	41.44	13.14	10.01	8.06	9.76	5.22	1.84	119.38
PK. LD.	407.00	416.00	407.00	407.00	302.00	241.00	241.00	259.00	352.00	389.00	435.00	444.00	
LD. FACT	0.44	0.42	0.40	0.39	0.44	0.41	0.44	0.39	0.38	0.42	0.42	0.39	
R.W.D.	0.98	1.20	1.31	0.78	0.06	0.03	0.10	0.12	0.19	0.19	0.33	0.61	
FL. FACT	0.71	0.70	0.71	0.80	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.87	
R.P.P	1.56	1.60	1.72	1.76	2.11	2.83	2.64	2.77	2.09	1.71	1.53	1.62	
L.U. FACT	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
POWER KW	126.63	102.50	87.38	126.21	132.88	98.81	106.04	101.01	133.76	163.38	180.74	150.22	1509.55
ENGY MWH	94.21	68.88	65.01	90.87	98.86	71.14	78.89	75.15	96.31	121.55	130.13	111.76	1102.78

1988	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
B.FLOW	2.50	2.00	1.70	2.80	28.80	42.80	14.60	11.40	9.90	12.00	7.70	3.90	140.10
P.FLOW	1.75	1.41	1.20	1.76	1.87	1.39	1.49	1.42	1.88	2.30	2.53	2.10	21.12
P.SPILL	0.75	0.59	0.50	1.04	26.93	41.41	13.11	9.98	8.02	9.70	5.17	1.80	118.98
PK. LD.	418.00	427.00	418.00	418.00	310.00	247.00	247.00	266.00	361.00	399.00	446.00	456.00	
LD. FACT	0.44	0.42	0.40	0.39	0.44	0.41	0.44	0.39	0.38	0.42	0.42	0.39	
R.W.D.	1.01	1.23	1.36	0.80	0.07	0.03	0.10	0.12	0.19	0.19	0.33	0.63	
FL. FACT	0.70	0.70	0.71	0.79	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.86	
R.P.P	1.52	1.56	1.67	1.72	2.05	2.76	2.58	2.70	2.04	1.67	1.49	1.57	
L.U. FACT	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
POWER KW	127.50	102.58	87.46	128.15	136.40	101.27	108.68	103.74	137.18	167.58	184.65	153.02	1536.21
ENGY MWH	94.86	68.94	65.07	92.27	101.48	72.91	80.86	77.18	98.77	124.68	132.94	113.85	1123.81

1989	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
B.FLOW	2.50	2.00	1.70	2.80	28.80	42.80	14.60	11.40	9.90	12.00	7.70	3.90	140.10
P.FLOW	1.75	1.41	1.20	1.78	1.92	1.43	1.53	1.46	1.94	2.36	2.59	2.14	21.53
P.SPILL	0.75	0.59	0.50	1.02	26.88	41.37	13.07	9.94	7.96	9.64	5.11	1.76	118.57
PK. LD.	429.00	439.00	429.00	429.00	318.00	254.00	254.00	273.00	371.00	410.00	458.00	468.00	
LD. FACT	0.44	0.42	0.40	0.39	0.44	0.41	0.44	0.39	0.38	0.42	0.42	0.39	
R.W.D.	1.04	1.27	1.39	0.82	0.07	0.03	0.11	0.13	0.20	0.20	0.34	0.64	
FL. FACT	0.70	0.70	0.71	0.78	1.00	1.00	1.00	1.00	1.00	1.00	0.98	0.85	
R.P.P	1.48	1.52	1.63	1.67	2.00	2.69	2.51	2.63	1.99	1.63	1.46	1.53	
L.U. FACT	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
POWER KW	127.59	102.67	87.54	130.01	139.92	104.14	111.76	106.47	140.98	172.20	188.87	155.76	1567.91
ENGY MWH	94.93	69.00	65.13	93.61	104.10	74.98	83.15	79.21	101.51	128.12	135.99	115.88	1145.60

1990	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
R.FLOW	2.50	2.00	1.70	2.80	28.80	42.80	14.60	11.40	9.90	12.00	7.70	3.90	140.10
P.FLOW	1.75	1.41	1.20	1.81	1.98	1.47	1.58	1.50	1.99	2.43	2.66	2.18	21.95
P.SPILL	0.75	0.59	0.50	0.99	26.82	41.33	19.02	9.90	7.91	9.57	5.04	1.72	118.15
PK. LD.	441.00	451.00	441.00	441.00	327.00	261.00	261.00	280.00	381.00	421.00	471.00	481.00	
LD. FACT	0.44	0.42	0.40	0.39	0.44	0.41	0.44	0.39	0.38	0.42	0.42	0.39	
R.W.D.	1.07	1.30	1.42	0.84	0.07	0.03	0.11	0.13	0.20	0.20	0.35	0.66	
FL. FACT	0.70	0.71	0.71	0.77	1.00	1.00	1.00	1.00	1.00	1.00	0.98	0.85	
R.P.P	1.44	1.48	1.59	1.63	1.95	2.62	2.44	2.56	1.93	1.58	1.42	1.49	
L.U. FACT	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
POWER KW	127.68	102.76	87.63	131.96	143.88	107.01	114.84	109.20	144.78	176.82	193.41	158.65	1598.61
ENGY MWH	95.00	69.06	65.19	95.01	107.05	77.05	85.44	81.24	104.24	131.55	139.25	118.03	1168.12

1991	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
R.FLOW	2.50	2.00	1.70	2.80	28.80	42.80	14.60	11.40	9.90	12.00	7.70	3.90	140.10
P.FLOW	1.75	1.41	1.20	1.84	2.04	1.51	1.62	1.55	2.05	2.50	2.73	2.22	22.43
P.SPILL	0.75	0.59	0.50	0.96	26.76	41.29	12.98	9.85	7.85	9.50	4.97	1.68	117.67
PK. LD.	454.00	465.00	454.00	454.00	337.00	269.00	269.00	289.00	393.00	434.00	486.00	496.00	
LD. FACT	0.44	0.42	0.40	0.39	0.44	0.41	0.44	0.39	0.38	0.42	0.42	0.39	
R.W.D.	1.10	1.34	1.47	0.87	0.07	0.04	0.11	0.14	0.21	0.21	0.36	0.68	
FL. FACT	0.70	0.71	0.71	0.76	1.00	1.00	1.00	1.00	1.00	1.00	0.97	0.84	
R.P.P	1.40	1.43	1.54	1.58	1.89	2.54	2.37	2.48	1.87	1.54	1.37	1.45	
L.U. FACT	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
POWER KW	127.79	102.87	87.72	133.96	148.28	110.29	118.36	112.71	149.34	182.28	198.58	161.89	1634.06
ENGY MWH	95.07	69.13	65.26	96.45	110.32	79.41	88.06	83.86	107.52	135.62	142.98	120.44	1194.12

1992	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
A.FLOW	2.50	2.00	1.70	2.80	28.80	42.80	14.60	11.40	9.90	12.00	7.70	3.90	140.10
P.FLOW	1.76	1.41	1.21	1.87	2.10	1.55	1.67	1.59	2.11	2.67	2.74	2.26	22.83
P.SPILL	0.74	0.59	0.49	0.93	26.70	41.25	12.93	9.81	7.79	9.43	4.96	1.64	117.27
PK. LD.	467.00	478.00	467.00	467.00	347.00	276.00	276.00	297.00	404.00	446.00	499.00	510.00	
LD. FACT	0.44	0.42	0.40	0.39	0.44	0.41	0.44	0.39	0.38	0.42	0.42	0.39	
R.W.D.	1.13	1.38	1.51	0.89	0.07	0.04	0.11	0.14	0.21	0.21	0.37	0.70	
FL. FACT	0.70	0.71	0.71	0.75	1.00	1.00	1.00	1.00	1.00	1.00	0.97	0.83	
R.P.P	1.36	1.39	1.50	1.54	1.83	2.47	2.31	2.42	1.82	1.49	1.34	1.41	
L.U. FACT	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.98	1.00	
POWER KW	127.89	102.97	87.81	135.85	152.68	113.16	121.44	115.83	153.52	187.32	199.89	164.81	1663.18
ENGY MWH	95.15	69.19	65.33	97.81	113.59	81.48	90.35	86.18	110.53	139.37	143.92	122.62	1215.54

1993	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
A.FLOW	2.50	2.00	1.70	2.80	28.80	42.80	14.60	11.40	9.90	12.00	7.70	3.90	140.10
P.FLOW	1.72	1.40	1.21	1.89	2.15	1.60	1.72	1.63	2.17	2.65	2.77	2.30	23.21
P.SPILL	0.78	0.60	0.49	0.91	26.65	41.20	12.88	9.77	7.73	9.35	4.93	1.60	116.89
PK. LD.	480.00	491.00	480.00	480.00	356.00	284.00	284.00	305.00	415.00	459.00	513.00	524.00	
LD. FACT	0.44	0.42	0.40	0.39	0.44	0.41	0.44	0.39	0.38	0.42	0.42	0.39	
R.W.D.	1.16	1.42	1.55	0.92	0.07	0.04	0.12	0.14	0.22	0.22	0.38	0.72	
FL. FACT	0.70	0.71	0.71	0.74	1.00	1.00	1.00	1.00	1.00	1.00	0.96	0.82	
R.P.P	1.33	1.36	1.46	1.50	1.79	2.40	2.24	2.35	1.78	1.45	1.30	1.37	
L.U. FACT	0.98	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.97	1.00	
POWER KW	125.56	102.27	87.91	137.64	156.64	116.44	124.96	118.95	157.70	192.78	201.88	167.65	1690.37
ENGY MWH	93.42	68.73	65.40	99.10	116.54	83.84	92.97	88.50	113.64	143.43	145.35	124.73	1235.55

1994	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
B.FLOW	2.50	2.00	1.70	2.80	28.80	42.80	14.60	11.40	9.90	12.00	7.70	3.90	140.10
P.FLOW	1.71	1.39	1.21	1.91	2.19	1.63	1.75	1.67	2.21	2.69	2.79	2.30	23.44
P.SPILL	0.79	0.61	0.49	0.89	26.61	41.17	12.85	9.73	7.69	9.31	4.91	1.60	116.66
PK. LD.	489.00	500.00	489.00	489.00	363.00	289.00	289.00	311.00	423.00	467.00	523.00	534.00	
LD. FACT	0.44	0.42	0.40	0.39	0.44	0.41	0.44	0.39	0.38	0.42	0.42	0.39	
R.W.D.	1.18	1.44	1.58	0.94	0.08	0.04	0.12	0.15	0.22	0.22	0.39	0.73	
FL. FACT	0.70	0.71	0.71	0.73	1.00	1.00	1.00	1.00	1.00	1.00	0.96	0.81	
R.P.P	1.30	1.33	1.43	1.47	1.75	2.36	2.20	2.31	1.74	1.43	1.27	1.34	
L.U. FACT	0.97	0.98	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.96	0.99	
POWER KW	124.53	101.45	87.97	138.81	159.72	118.49	127.16	121.29	160.74	196.14	203.27	167.52	1707.09
ENGY MWH	92.65	68.17	65.45	99.94	118.83	85.31	94.61	90.24	115.73	145.93	146.36	124.64	1247.86

1995	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
B.FLOW	2.50	2.00	1.70	2.80	28.80	42.80	14.60	11.40	9.90	12.00	7.70	3.90	140.10
P.FLOW	1.69	1.38	1.21	1.92	2.24	1.66	1.78	1.70	2.25	2.75	2.81	2.31	23.71
P.SPILL	0.81	0.62	0.49	0.88	26.56	41.14	12.82	9.70	7.65	9.25	4.89	1.59	116.39
PK. LD.	499.00	511.00	499.00	499.00	371.00	295.00	295.00	318.00	432.00	477.00	534.00	545.00	
LD. FACT	0.44	0.42	0.40	0.39	0.44	0.41	0.44	0.39	0.38	0.42	0.42	0.39	
R.W.D.	1.21	1.47	1.61	0.95	0.08	0.04	0.12	0.15	0.23	0.23	0.40	0.75	
FL. FACT	0.70	0.71	0.71	0.72	1.00	1.00	1.00	1.00	1.00	1.00	0.96	0.81	
R.P.P	1.28	1.30	1.40	1.44	1.72	2.32	2.16	2.26	1.71	1.40	1.25	1.32	
L.U. FACT	0.95	0.97	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.98	
POWER KW	123.43	100.49	88.04	140.05	163.24	120.95	129.80	124.02	164.16	200.34	204.79	167.97	1727.28
ENGY MWH	91.83	67.53	65.50	100.84	121.45	87.08	96.57	92.27	118.20	149.05	147.45	124.97	1262.74

1996	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
B.FLOW	2.50	2.00	1.70	2.80	28.80	42.80	14.60	11.40	9.90	12.00	7.70	3.90	140.10
P.FLOW	1.68	1.37	1.21	1.94	2.28	1.69	1.82	1.73	2.30	2.80	2.83	2.31	23.96
P.SPILL	0.82	0.63	0.49	0.86	26.52	41.11	12.78	9.67	7.60	9.20	4.87	1.59	116.14
PK. LD.	508.00	520.00	508.00	508.00	377.00	301.00	301.00	324.00	440.00	486.00	543.00	555.00	
LD. FACT	0.44	0.42	0.40	0.39	0.44	0.41	0.44	0.39	0.38	0.42	0.42	0.39	
R.W.D.	1.23	1.50	1.64	0.97	0.08	0.04	0.12	0.15	0.23	0.23	0.41	0.76	
FL. FACT	0.70	0.71	0.71	0.71	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.80	
R.P.P	1.25	1.28	1.38	1.41	1.69	2.27	2.11	2.22	1.67	1.37	1.23	1.29	
L.U. FACT	0.96	0.97	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.97	
POWER KW	122.47	99.73	88.11	141.11	165.88	123.41	132.44	126.36	167.20	204.12	206.03	168.35	1745.21
ENGY MWH	91.12	67.02	65.55	101.60	123.41	88.86	98.54	94.01	120.38	151.87	148.34	125.25	1275.95

1997	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
B.FLOW	2.50	2.00	1.70	2.80	28.80	42.80	14.60	11.40	9.90	12.00	7.70	3.90	140.10
P.FLOW	1.67	1.36	1.20	1.95	2.33	1.73	1.85	1.77	2.34	2.82	2.85	2.32	24.18
P.SPILL	0.83	0.64	0.50	0.85	26.47	41.07	12.75	9.63	7.56	9.18	4.85	1.58	115.92
PK. LD.	518.00	530.00	518.00	518.00	385.00	307.00	307.00	330.00	448.00	495.00	554.00	566.00	
LD. FACT	0.44	0.42	0.40	0.39	0.44	0.41	0.44	0.39	0.38	0.42	0.42	0.39	
R.W.D.	1.25	1.53	1.67	0.99	0.08	0.04	0.13	0.15	0.24	0.24	0.41	0.78	
FL. FACT	0.70	0.71	0.71	0.70	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.80	
R.P.P	1.23	1.26	1.35	1.39	1.65	2.22	2.07	2.18	1.64	1.35	1.20	1.27	
L.U. FACT	0.95	0.96	0.99	1.00	1.00	1.00	1.00	1.00	1.00	0.99	0.94	0.96	
POWER KW	121.45	98.92	87.30	142.23	169.40	125.87	135.08	128.70	170.24	205.49	207.52	168.74	1760.95
ENGY MWH	90.36	66.47	64.95	102.41	126.03	90.63	100.50	95.75	122.57	152.89	149.41	125.54	1287.52

1998	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
B.FLOW	2.50	2.00	1.70	2.80	28.80	42.80	14.60	11.40	9.90	12.00	7.70	3.90	140.10
P.FLOW	1.65	1.35	1.19	1.95	2.37	1.76	1.89	1.80	2.38	2.85	2.87	2.32	24.38
P.SPILL	0.85	0.65	0.51	0.85	26.43	41.04	12.71	9.60	7.52	9.15	4.83	1.58	115.72
PK. LD.	529.00	541.00	529.00	529.00	392.00	313.00	313.00	336.00	457.00	505.00	566.00	577.00	
LD. FACT	0.44	0.42	0.40	0.39	0.44	0.41	0.44	0.39	0.38	0.42	0.42	0.39	
R.W.D.	1.28	1.56	1.71	1.01	0.08	0.04	0.13	0.16	0.24	0.24	0.42	0.79	
FL. FACT	0.71	0.71	0.71	0.70	1.00	1.00	1.00	1.00	1.00	1.00	0.95	0.79	
R.P.P	1.20	1.23	1.32	1.36	1.62	2.18	2.03	2.14	1.61	1.32	1.18	1.24	
L.U. FACT	0.94	0.95	0.98	0.99	1.00	1.00	1.00	1.00	1.00	0.98	0.93	0.95	
POWER KW	120.38	98.06	86.50	141.68	172.48	128.33	137.72	131.04	173.66	207.65	208.99	169.10	1775.60
ENGY MWH	89.66	65.90	64.36	102.01	128.33	92.40	102.46	97.49	125.04	154.49	150.48	125.81	1298.32

1999	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
B.FLOW	2.50	2.00	1.70	2.80	28.80	42.80	14.60	11.40	9.90	12.00	7.70	3.90	140.10
P.FLOW	1.64	1.34	1.18	1.93	2.42	1.80	1.93	1.84	2.43	2.88	2.89	2.33	24.58
P.SPILL	0.86	0.66	0.52	0.87	26.38	41.00	12.67	9.56	7.47	9.12	4.81	1.57	115.52
PK. LD.	539.00	551.00	539.00	539.00	400.00	319.00	319.00	343.00	466.00	515.00	576.00	588.00	
LD. FACT	0.44	0.42	0.40	0.39	0.44	0.41	0.44	0.39	0.38	0.42	0.42	0.39	
R.W.D.	1.30	1.59	1.74	1.03	0.08	0.04	0.13	0.16	0.25	0.25	0.43	0.81	
FL. FACT	0.71	0.71	0.71	0.70	1.00	1.00	1.00	1.00	1.00	1.00	0.94	0.78	
R.P.P	1.18	1.21	1.30	1.33	1.59	2.14	1.99	2.09	1.58	1.29	1.16	1.22	
L.U. FACT	0.93	0.94	0.97	0.98	1.00	1.00	1.00	1.00	1.00	0.97	0.92	0.94	
POWER KW	119.44	97.32	85.81	140.48	176.00	130.79	140.36	133.77	177.08	209.80	210.45	169.44	1790.73
ENGY MWH	88.86	65.40	63.84	101.14	130.94	94.17	104.43	99.52	127.58	156.09	151.52	126.06	1309.49

2000	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
B.FLOW	2.50	2.00	1.70	2.80	28.80	42.80	14.60	11.40	9.90	12.00	7.70	3.90	140.10
P.FLOW	1.63	1.33	1.17	1.91	2.46	1.83	1.96	1.87	2.47	2.91	2.91	2.33	24.77
P.SPILL	0.87	0.67	0.53	0.89	26.34	40.97	12.64	9.53	7.43	9.09	4.79	1.57	115.33
PK. LD.	549.00	561.00	549.00	549.00	407.00	325.00	325.00	349.00	474.00	524.00	586.00	599.00	
LD. FACT	0.44	0.42	0.40	0.39	0.44	0.41	0.44	0.39	0.38	0.42	0.42	0.39	
R.W.D.	1.33	1.62	1.77	1.05	0.09	0.04	0.13	0.16	0.25	0.25	0.44	0.82	
FL. FACT	0.71	0.71	0.71	0.70	1.00	1.00	1.00	1.00	1.00	1.00	0.94	0.78	
R.P.P	1.16	1.19	1.28	1.31	1.56	2.10	1.96	2.06	1.55	1.27	1.14	1.20	
L.U. FACT	0.92	0.93	0.96	0.97	1.00	1.00	1.00	1.00	1.00	0.96	0.91	0.94	
POWER KW	118.64	96.60	86.14	139.32	179.08	133.26	143.00	136.11	180.12	211.74	211.76	169.74	1804.41
ENGY MWH	88.19	64.92	63.34	100.31	133.24	95.94	106.39	101.27	129.69	157.54	152.47	126.29	1319.58

2001	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
B.FLOW	2.50	2.00	1.70	2.80	28.80	42.80	14.60	11.40	9.90	12.00	7.70	3.90	140.10
P.FLOW	1.61	1.31	1.16	1.89	2.61	1.87	2.01	1.91	2.53	2.94	2.93	2.33	25.02
P.SPILL	0.89	0.69	0.54	0.91	26.29	40.93	12.59	9.49	7.37	9.06	4.77	1.57	115.08
PK. LD.	561.00	573.00	561.00	561.00	416.00	332.00	332.00	357.00	485.00	536.00	599.00	612.00	
LD. FACT	0.44	0.42	0.40	0.39	0.44	0.41	0.44	0.39	0.38	0.42	0.42	0.39	
R.W.D.	1.36	1.65	1.81	1.07	0.09	0.04	0.14	0.17	0.26	0.26	0.45	0.84	
FL. FACT	0.71	0.71	0.71	0.70	1.00	1.00	1.00	1.00	1.00	1.00	0.94	0.77	
R.P.P	1.13	1.16	1.25	1.28	1.53	2.06	1.92	2.01	1.52	1.24	1.11	1.17	
L.U. FACT	0.91	0.92	0.95	0.96	1.00	1.00	1.00	1.00	1.00	0.95	0.91	0.93	
POWER KW	117.50	95.77	84.37	137.99	183.04	136.12	146.08	139.23	184.30	214.33	213.44	170.07	1822.25
ENGY MWH	87.42	64.36	62.77	99.35	136.18	98.01	108.68	103.59	132.70	159.46	153.68	126.53	1332.73

2002	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
B.FLOW	2.50	2,00	1.70	2.80	28.80	42.80	14.60	11.40	9.90	12.00	7.70	3.90	140.10
P.FLOW	1.60	1.30	1.16	1.88	2.56	1.90	2.04	1.95	2.58	2.97	2.95	2.34	25.23
P.SPILL	0.90	0.70	0.55	0.92	26,24	40.90	12.56	9.45	7.32	9.03	4.75	1.56	114.87
PK. LD.	572.00	585.00	572.00	572.00	424.00	338.00	338.00	364.00	494.00	546.00	611.00	624.00	
LD. FACT	0.44	0.42	0.40	0.39	0.44	0.41	0.44	0.39	0.38	0.42	0.42	0.39	
R.W.D.	1.38	1.69	1.86	1.09	0.09	0.04	0.14	0.17	0.26	0.26	0.46	0.86	
FL. FACT	0.71	0.71	0.72	0.70	1.00	1.00	1.00	1.00	1.00	1.00	0.93	0.76	
R.P.P	1.11	1.14	1.22	1.26	1.50	2.02	1.88	1.97	1.49	1.22	1.09	1.15	
L.U. FACT	0.91	0.92	0.94	0.96	1.00	1.00	1.00	1.00	1.00	0.94	0.90	0.92	
POWER KW	116.59	94.98	83.70	136.82	186.56	138.58	148.72	141.96	187.72	216.48	214.98	170.33	1837.42
ENGY MWH	86.74	63.83	62.27	98.51	138.80	99.78	110.65	105.62	135.16	161.06	154.78	126.73	1343.93

2003	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
B.FLOW	2.50	2.00	1.70	2.80	28.80	42.80	14.60	11.40	9.90	12.00	7.70	3.90	140.10
P.FLOW	1.59	1.29	1.14	1.86	2.61	1.94	2.08	1.99	2.63	3.00	2.97	2.34	25.46
P.SPILL	0.91	0.71	0.56	0.94	26.19	40.86	12.52	9.41	7.27	9.00	4.73	1.56	114.64
PK. LD.	583.00	596.00	583.00	583.00	432.00	345.00	345.00	371.00	504.00	557.00	623.00	636.00	
LD. FACT	0.44	0.42	0.40	0.39	0.44	0.41	0.44	0.39	0.38	0.42	0.42	0.39	
R.W.D.	1.41	1.72	1.88	1.11	0.09	0.05	0.14	0.17	0.27	0.27	0.47	0.87	
FL. FACT	0.71	0.71	0.72	0.70	1.00	1.00	1.00	1.00	1.00	1.00	0.93	0.75	
R.P.P	1.09	1.12	1.20	1.23	1.47	1.98	1.84	1.94	1.46	1.20	1.07	1.13	
L.U. FACT	0.90	0.91	0.94	0.96	1.00	1.00	1.00	1.00	1.00	0.94	0.89	0.91	
POWER KW	115.71	94.29	83.05	136.70	190.08	141.45	151.80	144.69	191.52	218.85	216.49	170.56	1854.20
ENGY MWH	86.09	63.36	61.79	97.70	141.42	101.84	112.94	107.65	137.89	162.83	155.87	126.90	1356.29

2004	JAN	FEB	MAR	APR	MAY	JUNE	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
D.FLOW	2.50	2.00	1.70	2.80	28.80	42.80	14.60	11.40	9.90	12.00	7.70	3.90	140.10
P.FLOW	1.58	1.28	1.13	1.85	2.66	1.98	2.13	2.02	2.68	3.04	2.99	2.34	25.69
P.SPILL	0.92	0.72	0.57	0.95	26.14	40.82	12.47	9.38	7.22	8.96	4.71	1.56	114.41
PK. LD.	594.00	608.00	594.00	594.00	441.00	352.00	352.00	378.00	514.00	568.00	635.00	649.00	
LD. FACT	0.44	0.42	0.40	0.39	0.44	0.41	0.44	0.39	0.38	0.42	0.42	0.39	
R.W.D.	1.44	1.75	1.92	1.14	0.09	0.05	0.15	0.18	0.27	0.27	0.48	0.69	
FL. FACT	0.71	0.71	0.72	0.70	1.00	1.00	1.00	1.00	1.00	1.00	0.93	0.75	
R.P.P	1.07	1.10	1.18	1.21	1.44	1.94	1.81	1.90	1.43	1.17	1.05	1.11	
L.U. FACT	0.89	0.90	0.93	0.94	1.00	1.00	1.00	1.00	1.00	0.93	0.88	0.90	
POWER KW	114.87	93.56	82.43	134.62	194.04	144.32	154.88	147.42	195.32	221.22	217.98	170.77	1871.44
ENGY MWH	85.46	62.87	61.33	96.93	144.37	103.91	115.23	109.65	140.63	164.59	156.95	127.06	1369.00

2005	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
D.FLOW	2.50	2.00	1.70	2.80	28.80	42.80	14.60	11.40	9.90	12.00	7.70	3.90	140.10
P.FLOW	1.56	1.27	1.12	1.83	2.72	2.02	2.17	2.07	2.73	3.07	3.01	2.35	25.93
P.SPILL	0.94	0.73	0.58	0.97	26.08	40.78	12.43	9.33	7.17	8.93	4.69	1.55	114.17
PK. LD.	606.00	620.00	606.00	606.00	450.00	359.00	359.00	386.00	524.00	579.00	648.00	662.00	
LD. FACT	0.44	0.42	0.40	0.39	0.44	0.41	0.44	0.39	0.38	0.42	0.42	0.39	
R.W.D.	1.46	1.79	1.96	1.16	0.09	0.05	0.15	0.18	0.28	0.28	0.49	0.91	
FL. FACT	0.71	0.71	0.72	0.70	1.00	1.00	1.00	1.00	1.00	1.00	0.92	0.74	
R.P.P	1.05	1.08	1.16	1.18	1.41	1.90	1.77	1.86	1.41	1.15	1.03	1.08	
L.U. FACT	0.88	0.89	0.92	0.93	1.00	1.00	1.00	1.00	1.00	0.92	0.88	0.90	
POWER KW	113.99	92.86	81.78	133.49	198.00	147.19	157.96	150.54	199.12	223.59	219.58	170.95	1889.04
ENGY MWH	84.81	62.40	60.84	96.11	147.31	105.98	117.52	112.00	143.37	166.35	158.10	127.18	1381.98

2006	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
B.FLOW	2.50	2.00	1.70	2.80	28.80	42.80	14.60	11.40	9.90	12.00	7.70	3.90	140.10
P.FLOW	1.55	1.27	1.11	1.82	2.77	2.06	2.21	2.11	2.79	3.11	3.04	2.35	26.19
P.SPILL	0.95	0.73	0.59	0.98	26.03	40.74	12.39	9.29	7.11	8.89	4.66	1.55	113.91
PK. LD.	618.00	632.00	618.00	618.00	459.00	366.00	366.00	394.00	535.00	591.00	661.00	675.00	
LD. FACT	0.44	0.42	0.40	0.39	0.44	0.41	0.44	0.39	0.38	0.42	0.42	0.39	
R.W.D.	1.49	1.82	2.00	1.18	0.10	0.05	0.15	0.19	0.28	0.28	0.49	0.93	
FL. FACT	0.71	0.71	0.72	0.70	1.00	1.00	1.00	1.00	1.00	1.00	0.92	0.73	
R.P.P	1.03	1.05	1.13	1.16	1.39	1.87	1.74	1.82	1.38	1.13	1.01	1.06	
L.U. FACT	0.88	0.89	0.91	0.92	1.00	1.00	1.00	1.00	1.00	0.91	0.87	0.89	
POWER KW	113.14	92.19	81.15	132.40	201.96	150.06	161.04	153.66	203.30	226.18	221.15	171.08	1907.32
ENGY MWH	84.18	61.95	60.38	95.33	150.26	108.04	119.81	114.32	146.38	168.28	159.23	127.28	1395.44

2007	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
B.FLOW	2.50	2.00	1.70	2.80	28.80	42.80	14.60	11.40	9.90	12.00	7.70	3.90	140.10
P.FLOW	1.54	1.26	1.11	1.80	2.81	2.10	2.25	2.15	2.82	3.14	3.06	2.35	26.37
P.SPILL	0.96	0.74	0.59	1.00	25.99	40.70	12.35	9.25	7.08	8.86	4.64	1.55	113.73
PK. LD.	630.00	645.00	630.00	630.00	468.00	373.00	373.00	401.00	545.00	602.00	674.00	688.00	
LD. FACT	0.44	0.42	0.40	0.39	0.44	0.41	0.44	0.39	0.38	0.42	0.42	0.39	
R.W.D.	1.52	1.86	2.04	1.20	0.10	0.05	0.15	0.19	0.29	0.29	0.50	0.94	
FL. FACT	0.71	0.72	0.72	0.70	1.00	1.00	1.00	1.00	1.00	1.00	0.91	0.72	
R.P.P	1.01	1.03	1.11	1.14	1.36	1.83	1.71	1.79	1.35	1.11	0.99	1.04	
L.U. FACT	0.87	0.88	0.91	0.92	0.99	1.00	1.00	1.00	0.99	0.90	0.87	0.88	
POWER KW	112.33	91.50	80.55	131.36	204.48	152.93	164.12	156.39	205.08	228.55	222.66	171.17	1921.12

2008	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
B.FLOW	2.50	2.00	1.70	2.80	28.80	42.80	14.60	11.40	9.90	12.00	7.70	3.90	140.10
P.FLOW	1.54	1.25	1.10	1.79	2.84	2.14	2.30	2.19	2.84	3.17	3.08	2.35	26.58
P.SPILL	0.96	0.75	0.60	1.01	25.96	40.66	12.30	9.21	7.06	8.83	4.62	1.55	113.52
PK. LD.	643.00	658.00	643.00	643.00	477.00	380.00	380.00	409.00	556.00	614.00	687.00	702.00	
LD. FACT	0.44	0.42	0.40	0.39	0.44	0.41	0.44	0.39	0.38	0.42	0.42	0.39	
R.W.D.	1.54	1.90	2.08	1.23	0.10	0.05	0.16	0.19	0.29	0.30	0.50	0.96	
FL. FACT	0.71	0.72	0.72	0.70	1.00	1.00	1.00	1.00	1.00	1.00	0.91	0.72	
R.P.P	0.99	1.01	1.09	1.12	1.33	1.80	1.67	1.76	1.33	1.09	0.97	1.02	
L.U. FACT	0.87	0.87	0.90	0.91	0.98	1.00	1.00	1.00	0.98	0.90	0.87	0.87	
POWER KW	112.31	90.83	79.93	130.27	206.51	155.80	167.20	159.51	207.23	231.13	224.09	171.22	1936.04
ENGY MWH	83.56	61.04	59.47	93.80	153.64	112.18	124.40	118.68	149.20	171.96	161.34	127.39	1416.66

2009	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
B.FLOW	2.50	2.00	1.70	2.80	28.80	42.80	14.60	11.40	9.90	12.00	7.70	3.90	140.10
P.FLOW	1.55	1.24	1.09	1.77	2.87	2.18	2.34	2.23	2.87	3.21	3.10	2.35	26.82
P.SPILL	0.95	0.76	0.61	1.03	25.93	40.62	12.26	9.17	7.03	8.79	4.60	1.55	113.28
PK. LD.	656.00	671.00	656.00	656.00	487.00	388.00	388.00	417.00	567.00	627.00	701.00	716.00	
LD. FACT	0.44	0.42	0.40	0.39	0.44	0.41	0.44	0.39	0.38	0.42	0.42	0.39	
R.W.D.	1.54	1.92	2.12	1.25	0.10	0.05	0.16	0.20	0.30	0.30	0.50	0.98	
FL. FACT	0.71	0.72	0.72	0.70	1.00	1.00	1.00	1.00	1.00	1.00	0.91	0.71	
R.P.P	0.97	0.99	1.07	1.09	1.31	1.76	1.64	1.72	1.30	1.06	0.95	1.00	
L.U. FACT	0.87	0.87	0.89	0.90	0.97	1.00	1.00	1.00	0.97	0.89	0.88	0.87	
POWER KW	113.07	90.61	79.34	129.23	208.77	159.08	170.72	162.63	209.37	233.88	225.57	171.23	1953.48
ENGY MWH	84.12	60.89	59.03	93.05	155.32	114.54	127.02	121.00	150.75	174.00	162.41	127.40	1429.51

2010	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
B.FLOW	2.50	2.00	1.70	2.80	28.80	42.80	14.60	11.40	9.90	12.00	7.70	3.90	140.10
P.FLOW	1.56	1.25	1.08	1.76	2.90	2.23	2.39	2.28	2.90	3.24	3.12	2.37	27.08
P.SPILL	0.94	0.75	0.62	1.04	25.90	40.57	12.21	9.12	7.00	8.76	4.58	1.53	113.02
PK. LD.	670.00	685.00	670.00	670.00	497.00	396.00	396.00	426.00	579.00	640.00	716.00	731.00	
LD. FACT	0.44	0.42	0.40	0.39	0.44	0.41	0.44	0.39	0.38	0.42	0.42	0.39	
R.W.D.	1.54	1.92	2.16	1.28	0.10	0.05	0.16	0.20	0.31	0.31	0.50	0.99	
FL. FACT	0.71	0.72	0.72	0.71	1.00	1.00	1.00	1.00	1.00	1.00	0.91	0.71	
R.P.P	0.95	0.97	1.04	1.07	1.28	1.72	1.61	1.69	1.27	1.04	0.93	0.98	
L.U. FACT	0.88	0.87	0.88	0.89	0.96	1.00	1.00	1.00	0.96	0.88	0.89	0.87	
POWER KW	113.85	91.24	78.72	128.16	211.02	162.36	174.24	166.14	211.31	236.04	227.09	172.28	1972.45
ENGY MWH	84.70	61.31	58.57	92.28	157.00	116.90	129.63	123.61	152.14	175.61	163.50	128.18	1443.44

2011	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
B.FLOW	2.50	2.00	1.70	2.80	28.80	42.80	14.60	11.40	9.90	12.00	7.70	3.90	140.10
P.FLOW	1.57	1.26	1.07	1.75	2.93	2.27	2.44	2.32	2.92	3.27	3.14	2.38	27.33
P.SPILL	0.93	0.74	0.63	1.05	25.87	40.53	12.16	9.00	6.98	8.73	4.56	1.52	112.77
PK. LD.	682.00	698.00	682.00	682.00	507.00	404.00	404.00	434.00	590.00	652.00	729.00	745.00	
LD. FACT	0.44	0.42	0.40	0.39	0.44	0.41	0.44	0.39	0.38	0.42	0.42	0.39	
R.W.D.	1.54	1.92	2.20	1.30	0.11	0.05	0.17	0.20	0.31	0.31	0.50	0.99	
FL. FACT	0.71	0.72	0.72	0.71	1.00	1.00	1.00	1.00	1.00	0.99	0.91	0.71	
R.P.P	0.93	0.96	1.03	1.05	1.26	1.69	1.58	1.65	1.25	1.02	0.91	0.96	
L.U. FACT	0.89	0.88	0.88	0.88	0.96	1.00	1.00	1.00	0.95	0.87	0.89	0.88	
POWER KW	114.49	91.80	78.22	127.28	213.28	165.64	177.76	169.26	212.92	238.03	228.36	173.37	1990.40
ENGY MWH	85.18	61.69	58.20	91.64	158.68	119.26	132.25	125.91	153.30	177.09	164.42	128.99	1456.63

2012	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
B.FLOW	2.50	2.00	1.70	2.80	28.80	42.80	14.60	11.40	9.90	12.00	7.70	3.90	140.10
P.FLOW	1.58	1.27	1.07	1.73	2.96	2.32	2.49	2.37	2.95	3.30	3.15	2.40	27.58
P.SPILL	0.92	0.73	0.63	1.07	25.84	40.48	12.11	9.03	6.95	8.70	4.55	1.50	112.52
PK. LD.	696.00	712.00	696.00	696.00	517.00	412.00	412.00	443.00	602.00	665.00	744.00	760.00	
LD. FACT	0.44	0.42	0.40	0.39	0.44	0.41	0.44	0.39	0.38	0.42	0.42	0.39	
R.W.D.	1.54	1.92	2.25	1.33	0.11	0.05	0.17	0.21	0.32	0.32	0.50	0.99	
FL. FACT	0.71	0.72	0.72	0.71	1.00	1.00	1.00	1.00	0.99	0.99	0.91	0.71	
R.P.P	0.91	0.94	1.01	1.03	1.23	1.66	1.54	1.62	1.22	1.00	0.90	0.94	
L.U. FACT	0.89	0.88	0.87	0.88	0.95	1.00	1.00	1.00	0.95	0.87	0.90	0.88	
POWER KW	115.21	92.39	77.66	126.29	215.54	168.92	181.28	172.77	214.66	240.16	229.76	174.49	2009.13
ENGY MWH	85.72	62.08	57.78	90.93	160.36	121.62	134.87	128.54	154.56	178.68	165.43	129.82	1470.39

2013	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
B.FLOW	2.50	2.00	1.70	2.80	28.80	42.80	14.60	11.40	9.90	12.00	7.70	3.90	140.10
P.FLOW	1.59	1.28	1.07	1.72	2.99	2.36	2.54	2.42	2.97	3.32	3.17	2.41	27.84
P.SPILL	0.91	0.72	0.63	1.08	25.81	40.44	12.06	8.90	6.93	8.68	4.53	1.49	112.26
PK. LD.	710.00	726.00	710.00	710.00	527.00	420.00	420.00	452.00	614.00	678.00	759.00	775.00	
LD. FACT	0.44	0.42	0.40	0.39	0.44	0.41	0.44	0.39	0.38	0.42	0.42	0.39	
R.W.D.	1.54	1.92	2.26	1.36	0.11	0.06	0.17	0.21	0.32	0.32	0.50	0.99	
FL. FACT	0.71	0.72	0.72	0.71	1.00	1.00	1.00	1.00	0.99	0.99	0.91	0.71	
R.P.P	0.90	0.92	0.99	1.01	1.21	1.63	1.52	1.59	1.20	0.98	0.88	0.93	
L.U. FACT	0.90	0.89	0.87	0.87	0.94	1.00	1.00	1.00	0.94	0.87	0.90	0.89	
POWER KW	115.91	92.95	77.87	125.34	217.79	172.20	184.80	176.28	216.39	241.82	231.11	175.57	2028.04
ENGY MWH	86.24	62.46	57.94	90.25	162.04	123.98	137.49	131.15	155.80	179.91	166.40	130.62	1484.29

2014	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
B.FLOW	2.50	2.00	1.70	2.80	28.80	42.80	14.60	11.40	9.90	12.00	7.70	3.90	140.10
P.FLOW	1.60	1.28	1.08	1.72	3.02	2.41	2.59	2.47	2.99	3.34	3.19	2.43	28.13
P.SPILL	0.90	0.72	0.62	1.08	25.78	40.39	12.01	8.93	6.91	8.66	4.51	1.47	111.97
PK. LD.	725.00	741.00	725.00	725.00	538.00	429.00	429.00	461.00	626.00	692.00	774.00	791.00	
LD. FACT	0.44	0.42	0.40	0.39	0.44	0.41	0.44	0.39	0.38	0.42	0.42	0.39	
R.W.D.	1.54	1.92	2.26	1.37	0.11	0.06	0.18	0.22	0.33	0.32	0.50	0.99	
FL. FACT	0.71	0.72	0.72	0.71	1.00	1.00	1.00	1.00	0.99	0.99	0.91	0.71	
R.P.P	0.88	0.90	0.97	0.99	1.18	1.59	1.48	1.56	1.18	0.96	0.86	0.91	
L.U. FACT	0.90	0.90	0.88	0.87	0.93	1.00	1.00	1.00	0.93	0.88	0.91	0.89	
POWER KW	116.62	93.53	78.42	125.24	220.28	175.89	188.76	179.79	218.11	243.47	232.41	176.67	2049.18
ENGY MWH	86.77	62.85	58.34	90.17	163.89	126.64	140.44	133.76	157.04	181.14	167.34	131.44	1499.82

2015	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
B.FLOW	2.50	2.00	1.70	2.80	28.80	42.80	14.60	11.40	9.90	12.00	7.70	3.90	140.10
P.FLOW	1.61	1.29	1.08	1.73	3.06	2.46	2.64	2.52	3.02	3.36	3.21	2.44	28.42
P.SPILL	0.89	0.71	0.62	1.07	25.74	40.34	11.96	8.88	6.88	8.64	4.49	1.46	111.68
PK. LD.	739.00	756.00	739.00	739.00	549.00	437.00	437.00	470.00	639.00	706.00	790.00	807.00	
LD. FACT	0.44	0.42	0.40	0.39	0.44	0.41	0.44	0.39	0.38	0.42	0.42	0.39	
R.W.D.	1.54	1.92	2.26	1.37	0.12	0.06	0.18	0.22	0.34	0.32	0.50	0.99	
FL. FACT	0.71	0.72	0.72	0.71	1.00	1.00	1.00	1.00	0.98	0.99	0.91	0.71	
R.P.P	0.86	0.88	0.95	0.97	1.16	1.56	1.46	1.53	1.15	0.94	0.84	0.89	
L.U. FACT	0.91	0.90	0.88	0.87	0.92	1.00	1.00	1.00	0.92	0.88	0.91	0.90	
POWER KW	117.26	94.08	78.91	126.04	222.76	179.17	192.28	183.30	219.95	245.05	233.75	177.73	2070.28
ENGY MWH	87.24	63.22	58.71	90.75	165.73	129.00	143.06	136.38	158.37	182.31	168.30	132.21	1515.30

MAXIMUM	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
B.FLOW	2.50	2.00	1.70	2.80	28.80	42.80	14.60	11.40	9.90	12.00	7.70	3.90	140.10
P.FLOW	1.77	1.43	1.23	1.98	3.84	3.84	3.84	3.78	3.70	3.81	3.52	2.71	35.47
P.SPILL	0.73	0.57	0.47	0.82	24.96	38.96	10.76	7.62	6.20	8.19	4.18	1.19	104.63
LOAD	280.00	280.00	280.00	280.00	280.00	280.00	280.00	280.00	280.00	280.00	280.00	280.00	
LD. FACT	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
R.W.D.	1.54	1.92	2.26	1.37	0.13	0.09	0.26	0.34	0.39	0.32	0.50	0.99	
FL. FACT	0.71	0.72	0.72	0.71	1.00	1.00	1.00	0.98	0.96	0.99	0.91	0.71	
POWER KW	129.23	104.39	89.49	144.14	280.00	280.00	280.00	275.62	269.48	277.64	256.15	197.72	2583.86
ENGY MWH	96.15	70.15	66.58	103.78	208.32	201.60	208.32	205.06	194.02	206.57	184.43	147.11	1892.08

MAX FIRM	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	TOTAL
B.FLOW	1.00	0.70	0.60	0.50	12.00	35.30	11.40	8.70	12.60	7.40	5.10	2.70	98.00
P.FLOW	0.75	0.55	0.48	0.41	3.81	3.84	3.78	3.61	3.84	3.48	3.10	1.91	29.56
P.SPILL	0.25	0.15	0.12	0.09	8.19	31.46	7.62	5.09	8.76	3.92	2.00	0.79	68.44
LOAD	280.00	280.00	280.00	280.00	280.00	280.00	280.00	280.00	280.00	280.00	280.00	280.00	
LD. FACT	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	
R.W.D.	3.84	5.49	6.41	7.69	0.32	0.11	0.34	0.44	0.31	0.52	0.75	1.42	
FL. FACT	0.75	0.78	0.80	0.82	0.99	1.00	0.98	0.94	1.00	0.91	0.81	0.71	
POWER KW	54.72	39.81	34.85	29.88	277.64	280.00	275.62	263.05	279.47	253.72	225.58	139.17	2153.50
ENGY MWH	40.71	26.75	25.93	21.51	206.57	201.60	205.06	195.71	201.22	188.77	162.42	103.54	1579.78

APPENDIX D

- COMMUNITY DESCRIPTION

(EXCERPT FROM:

"REMOTE COMMUNITY DEMONSTRATION PROGRAM -

NEWFOUNDLAND REGION - OVERVIEW STUDY")

REMOTE COMMUNITY DEMONSTRATION PROGRAM - NEWFOUNDLAND REGION - OVERVIEW STUDY

Prepared for:

Conservation and Renewable Energy Office
Energy, Mines and Resources Canada
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Prepared by:

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and

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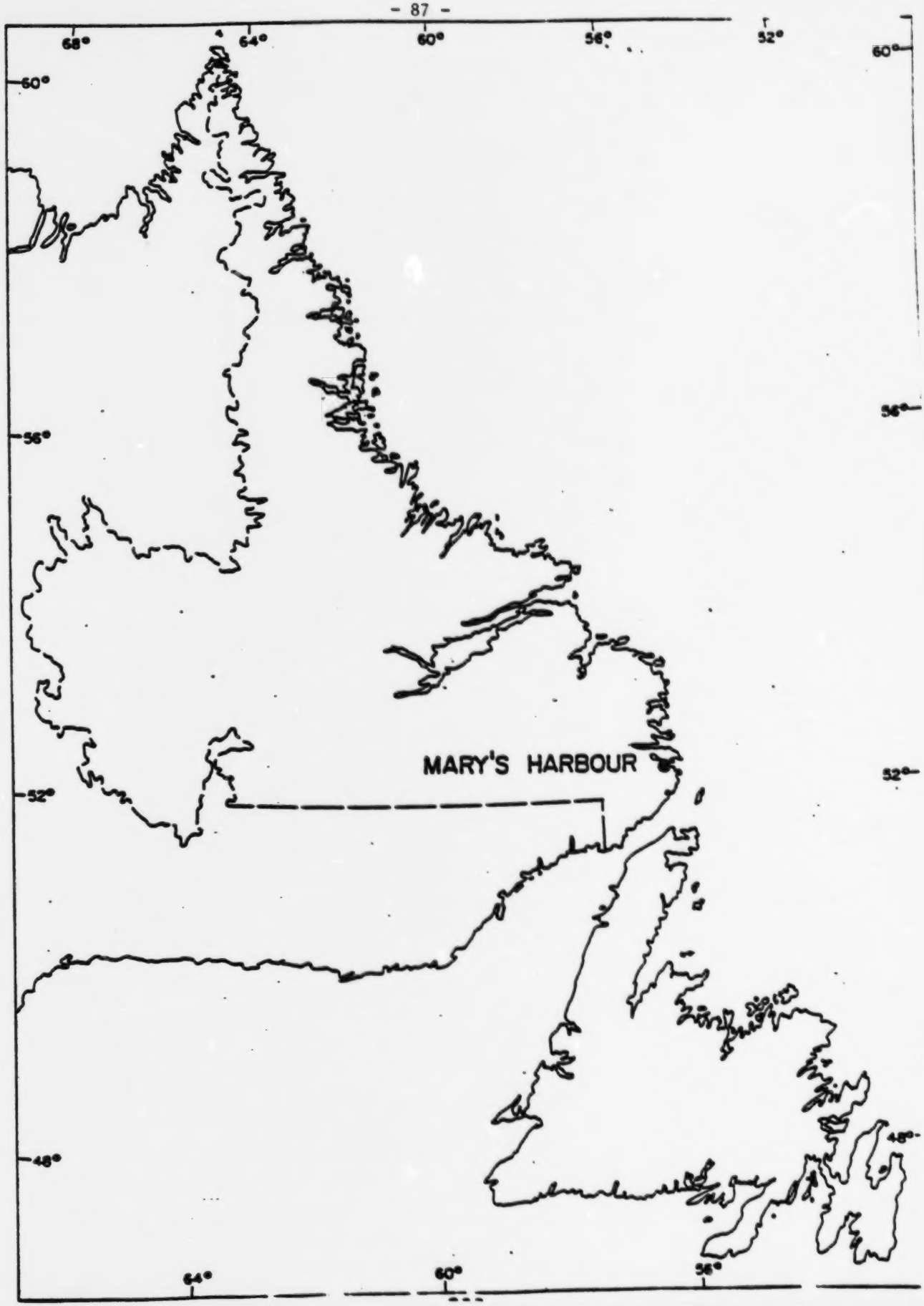
4.8 REMOTE COMMUNITY ANALYSIS

Load Centre: Mary's Harbour, Labrador

Communities Serviced: Mary's Harbour, Lodge Bay

Comments: The Mary's Harbour diesel generating plant services the communities of Mary's Harbour and Lodge Bay. Profile information for these two communities will be presented separately beginning with Mary's Harbour.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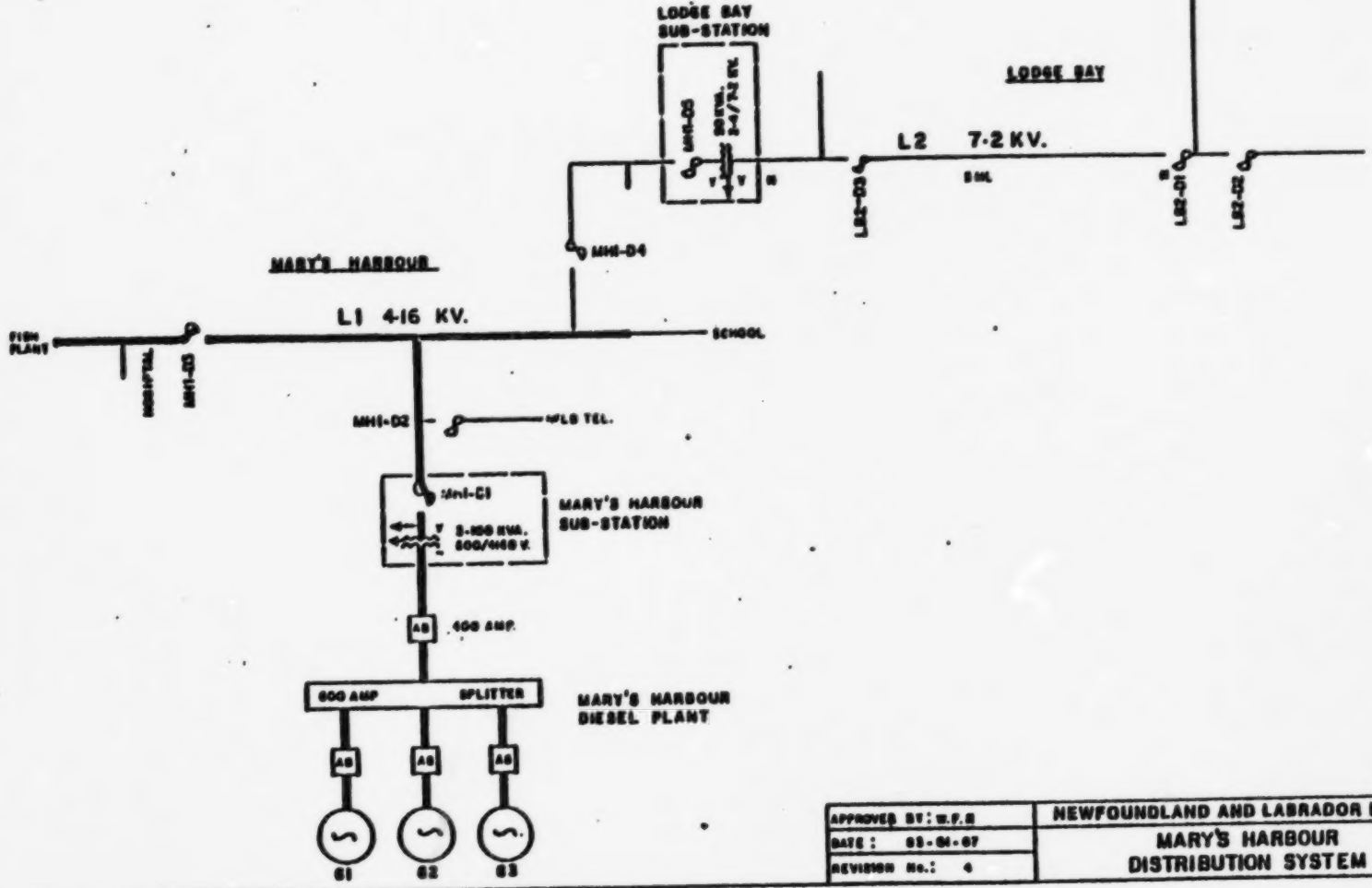
MARY'S HARBOUR



APPROVED BY: W.P.R	NEWFOUNDLAND AND LABRADOR HYDRO	SH 1 of 1
DATE: 88-04-07	MARY'S HARBOUR DISTRIBUTION SYSTEM	DWG. No. 302-1
REVISION No.: 4		

4.8.1 REMOTE COMMUNITY ANALYSIS

Community Profile: Mary's Harbour

Status: Incorporated

Location: Lat: 52° 19' N
Long: 55° 49' W

Sources of Information:

Publications and Articles

Arco Co. Ltd. and Terpstra Engineering Ltd., "Mary's Harbour Municipal Plan," February 1980.

Them Days Magazine, "Alluring Labrador," October 1980.

Place Name Codes of Newfoundland and Labrador, January 1981.

Selected Characteristics - Newfoundland - 1981 Census of Canada.

Interviews and Correspondence

Newfoundland Statistics Agency, May 1983.

Statistics Canada, May 1983.

Newfoundland and Labrador Hydro/Power Distribution District, May 1983.

Royal Canadian Mounted Police, June 1983.

Department of Municipal Affairs and Housing, May 1983.

Woodward's Oil Limited, June 1983.

Department of Health, June 1983.

Department of Transportation, June 1983.

Intergovernmental Affairs Secretariat, June 1983.

A. History and Current Status

1. Mary's Harbour was originally settled in the 1700's as a seal and salmon operation. It was also used as a winter residence for people in the community of Battle Harbour. The community has relied traditionally on trapping, forest resources and the fishery. At present the fishery is the mainstay of the economy, with summer migration to the fishing stations of Battle Harbour, Indian Cove, Matthews Cove, Camp Island, Carrol's Cove and Henley Harbour.

Mary's Harbour acts as a sub-regional administrative centre for this area of the southeastern Labrador coast. The community has a branch office of the provincial Department of Social Services and a detachment of the R.C.M.P. which services the communities from Charlottetown to Lodge Bay. The medical facilities serve communities from Fox Harbour to Lodge Bay. With the availability of an airstrip it is anticipated that Mary's Harbour may increase its role as an administrative centre for the region. In addition, the community has a relatively young population with over 70% being less than 45 years of age. Both these factors indicate there is potential for maintained growth in the community of Mary's Harbour.

2. Demographics

1981 Population: 408

Historic Population:

Year	Population	Increase	Growth %	Average Annual Growth %
1945	53			
1951	83	30	57	9.5
1956	212	129	155	31.0
1961	264	52	25	5.0
1966	*47	-217	-82	-16.4
1971	134	87	185	37.0
1976	363	229	171	34.2
1981	408	45	12	2.0

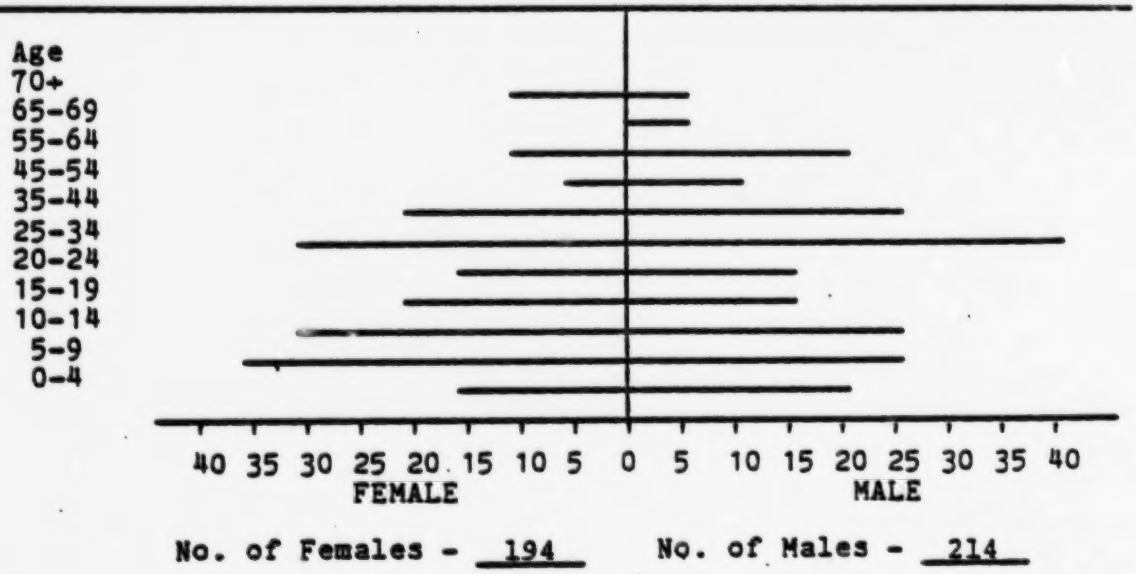
The erratic trend could be due to real population changes, or difficulty in obtaining accurate census data due to the seasonal migration of fishermen to summer stations.

Source Note: Mary's Harbour Municipal Plan
1981 Census of Canada

Projected Future Population Growth:

1985 - 500 1990 - 625

Population Structure by Age and by Gender - 1981



No. of Females - 194 No. of Males - 214

Footnotes

There is a fairly young population; therefore there is potential for sustained population growth in the community.

Source Note: 1981 Census of Canada.

B. COMMUNITY SERVICES

1. Water

Source:

Lake ____ River __X__ Wells __X__ Other ____

Distribution:

Pipe __X__ Truck ____ Individual Systems __X__ None ____

Serving:

Government Buildings __X__ Commercial Buildings __X__ Residences __X__ Standpipes ___

Treatment:

Sedimentation ____ Filtration ____ Chlorination ____
Fluoridation ____ None __X__

---

2. Sewage

Collection System:

Pipe __X__ Truck ____ Individual Systems __X__ None ____

Serving:

Government Buildings __X__ Commercial Buildings __X__ Residences __X__

Disposal:

Lagoon __X__ Septic Tanks __X__ Treatment Plant ____ None ____

---

3. Solid Waste Disposal

Garbage Collection Organized: Yes __X__ No ____
Landfille Site Utilized: Yes ____ No __X__
Other: __open dump__ Yes __X__ No ____

---

4. Police Protection

R.C.M.P.: Yes X No ____

Patrolled from: Mary's Harbour

---

5. Fire Protection Organized:

Organized: Yes ____ No X

Equipment: None

C. COMMUNITY FACILITIES

1. Health

Clinic in Community: Yes X No ____

Size of Facility: 588.6 M^2

Staff: Doctors 1 Nurses 2 Nursing Assistants

Other 1 visiting I.G.A. doctor

---

2. Education

School located in community: Yes X No ____

Grades: Kindergarten to Grade 11

Size: N/A Classrooms: N/A Teachers: 7

---

3. Residential

(1) Number of occupied private dwellings: 85
(2) Number of houses with sewer and water: 50% have piped sewage. 100% have access to wells in summer; 25% in winter.
(3) Housing Condition: very good, 26%; good, 41%; fair, 26%; poor, 7%
(4) Number of owned homes: 80
(5) Number of rented homes: 5
(6) Number of single detached homes: 80
(7) Number of single attached homes: 5
(8) Average number of persons per private household: 4.6
(9) Dwellings heated by steam or hot water: 0
(10) Dwellings heated by hot air: 25
(11) Dwellings heated with stove or space heater: 60
(12) Dwellings heated by electric heat: 0
(13) Other: 0

4. Community/Institutional/Commercial/Industrial Buildings

General Store	General Store
General Store	Plumbing and Heating Shop
General Store	Skidoo and Appliance Shop
General Store	Skidoo and Appliance Shop
General Store	Church
General Store	Community Hall

D. ECONOMIC ACTIVITIES

1. Fishing
2. Forestry
3. Trapping

E. COMMUNICATION LINKS

	Yes	No	Comments
Post Office	X		
Television	X		CBC
Radio	X		various signals
Telephone	X		exchange service
High Frequency Radio		X	
Operated By:			

F. TRANSPORTATION LINKS

1. Access to Community By Scheduled Services

	Carrier	Type
Air	Labrador Airways	scheduled & charter
Marine	CN Coastal Boats	scheduled
Bus	Not Applicable	
Other	Not Applicable	

2. Local Transportation

	Yes	No	Type
Boats	X		
Snowmobiles	X		
Cars		X	
Heavy Vehicles	X		
Other		X	

G. DIESEL ELECTRIC GENERATION

1. Owner: Newfoundland Labrador Hydro/Power Distribution District

2. Diesel Type: 2 - 250 kw Cat. with B.B.C. Generators
1 - 300 kw Cat. with Tamper Generator

3. Diesel Fuel Consumption:

	1981	1982
Annual Fuel Use (litres)	328 915	351,400
Annual Fuel Cost	$111,852.00	$138,026.00
Cost per Litres	$0.34	$0.39
Cost Increase		15%

4. Electricity Demand - Historical and Predicted (mwh):

1980	813	1985	1143
1981	854	1986	1200
1982	990	1987	1258
1983	1040	1988	1320
1984	1090		

5. Peak Load - Historical and Predicted (kw):

1980	270	1985	388
1981	288	1986	407
1982	345	1987	428
1983	352	1988	449
1984	369		

H. ASSESSMENT OF RESOURCES - Mary's Harbour - Total Load Center

Small Scale Hydro Potential

There are three possible sites within approximately 7 km. of the nearest transmission line. One is on a small river, with an estimated capacity of 130 kw. through a head of approximately 4 M.

Two larger sites are located on Mary's Harbour River. The larger of the two is close to the community, with an estimated capacity of 1,560 kw. through a head of approximately 4 M. The smaller site has an estimated capacity of 730 kw. through a head of approximately 6 M. Some potential exists to increase the head of this site, thereby increasing capacity. This site is located approximately 7 km. from the community.

Wood Resources

A substantial quantity of fuelwood exists in the Mary's Harbour area. The supply is probably in excess of the community's needs. Information obtained from Statistics Canada indicates that this resource is currently being used by 73% of the residents of both Mary's Harbour and Lodge Bay. The potential to increase the use of wood as a primary or secondary fuel requires further study.

Peat Resources

No published fuel peat inventories are available for this area, and consequently, no definitive conclusions can be made about this alternative.

Wind Resources

The published data base on the wind regime for this area is insufficient to formulate definitive conclusions about this alternative.

Cogeneration - District Heating - Heat Recovery

Information obtained from Newfoundland and Labrador Hydro indicates that there is potential for a heat recovery project in Mary's Harbour at the community medical clinic, which is located close to the diesel plant.

Conservation Measures

No data base exists to evaluate conservation options.

Assessment

Of the three possible small scale hydro sites near the community of Mary's Harbour, the site near the community on Mary's River is the most promising. The estimated capital cost to develop this site is between $1.4 and $2.1 million. This yields an Annual Equivalent Cost of Energy of approximately $0.34 per kwh. While this is somewhat higher than the cost for diesel generated electricity, the cost is based on the mean value of the capital cost estimates. If capital costs for the development could be kept near $1.4 million, the Annual Equivalent Cost for Energy from the development would be competitive with diesel generation. For this reason, the potential for small scale hydro development at Mary's Harbour warrants closer examination.

The data base on wood, peat, wind and the potential for conservation is either non-existent or inadequate to seriously evaluate these options. More detailed research and analysis would have to be conducted before these options could be promoted or dismissed as potential contributors to heating and/or electrical generation requirements.

The community medical clinic in Mary's Harbour is within close proximity to the diesel plant and is a potential candidate for a heat recovery project.

1982 ENERGY PROFILE

LOAD CENTER: Mary's Harbour COMMUNITY: Mary's Harbour

	ELECTRICITY (kwh)	FURNACE OIL (litres)	STOVE OIL (litres)	HEAVY FUEL OIL (litres)	FUELWOO (tonnes
Residential	611 497		136 383		1 69
Commercial	23 555				
Industrial					
Government	172 735				
Street Lighting	15 444				
TOTAL	823 231		136 383		1 69

1982 ENERGY PROFILE

LOAD CENTER: Mary's Harbour COMMUNITY: Mary's Harbour

	ELECTRICITY (GJ)	FURNACE OIL (GJ)	STOVE OIL (GJ)	HEAVY FUEL OIL (GJ)	FUELWOOD (GJ)	TOTAL (GJ)
Residential	2 201		5 139		13 717	21 057
Commercial	85					85
Industrial						
Government	622					622
Street Lighting	56					56
TOTAL	2 964		5 139		13 717	21 820

4.8.2 REMOTE COMMUNITY ANALYSIS

Community Profile: Lodge Bay, Labrador

Status: Unincorporated

Location: Lat: 52° 19' N
Long: 55° 49' W

Sources of Information:

Publications and Articles

Them Days Magazine, "Alluring Labrador," October 1980.

Place Name Codes of Newfoundland and Labrador, January 1981.

Selected Characteristics - Newfoundland - 1981 Census of Canada.

Interviews and Correspondence

Newfoundland Statistics Agency, May 1983.

Statistics Canada, May 1983.

Newfoundland and Labrador Hydro/Power Distribution District, May 1983.

Royal Canadian Mounted Police, June 1983.

Department of Municipal Affairs and Housing, May 1983.

Woodward's Oil Limited, June 1983.

Department of Health, June 1983.

Department of Transportation, June 1983.

Intergovernmental Affairs Secretariat, June 1983.

A. History and Current Status

1. Lodge Bay was originally settled in the 1700's as a seal and salmon operation. At present the fishery is the mainstay of the economy.

2. Demographics

1981 Population: 124

Historic Population

Year	Population	Increase	Growth %	Average Annual Growth %
1976	129			
1981	124	-5	-4%	-0.8%

Source Note: 1981 Census of Canada.

B. COMMUNITY SERVICES

1. Water

Source:

Lake ____ River X Wells X Other None

Distribution:

Pipe X Truck ____ Individual Systems X None ____

Serving:

Government Buildings ____ Commercial Buildings X Residences X Standpipes ____

Treatment:

Sedimentation ____ Filtration ____ Chlorination ____
Fluoridation ____ None X

2. Sewage

Collection System:

Pipe _____ Truck _____ Individual Systems X None _____

Serving:

Government Buildings _____ Commercial Buildings _____ Residences X

Disposal:

Lagoon X Septic Tanks _____ Treatment Plant _____ None _____

---

3. Solid Waste Disposal

Garbage Collection Organized:	Yes _____	No X
Landfill Site Utilized:	Yes _____	No X
Other:	Yes _____	No X

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4. Police Protection

R.C.M.P.: Yes X No _____

Patrolled from: Mary's Harbour

---

5. Fire Protection Organized

Organized: Yes _____ No X

Equipment: None

C. COMMUNITY FACILITIES

1. Health

Clinic in Community: Yes _____ No X

Size of Facility: _____

Staff: Doctors: _____ Nurses: _____

Other: _____

2. Education

School located in community: Yes X No _____

Grades: Kindergarten to Grade 9

Size: N/A Classrooms: N/A Teachers: 3

3. Residential

(1) Number of occupied private dwellings: N/A
(2) Number of houses with sewer and water: N/A
(3) Housing Condition: N/A
(4) Number of owned homes: N/A
(5) Number of rented homes: N/A
(6) Number of single detached homes: N/A
(7) Number of single attached homes: N/A
(8) Average number of persons per private household: N/A
(9) Dwellings heated by steam or hot water: N/A
(10) Dwellings heated by hot air: N/A
(11) Dwellings heated with stove or space heater: N/A
(12) Dwellings heated by electric heat: N/A
(13) Other: _____ N/A

4. Community/Institutional/Commercial/Industrial Buildings

N/A

D. ECONOMIC ACTIVITIES

N/A

E. COMMUNICATION LINKS

				Comments
Post Office	Yes	X	No	
Television	Yes	X	No	
Radio	Yes	X	No	
Telephone	Yes	X	No	
High Frequency Radio	Yes	X	No	
Operated By:				

F. TRANSPORTATION LINKS

1. Access to Community By Scheduled Services

	Carrier	Type
Air	Labrador Airways	Scheduled & Charter
Marine	CN Coastal Boats	Scheduled
Bus	Not Available	
Other	Not Available	

2. Local Transportation

	Yes	No	Type
Boats	X		
Snowmobiles	X		
Cars		X	
Heavy Vehicles	X		
Other		X	

1982 ENERGY PROFILE

LOAD CENTER: Mary's Harbour COMMUNITY: Lodge Bay

	ELECTRICITY (kwh)	FURNACE OIL (litres)	STOVE OIL (litres)	HEAVY FUEL OIL (litres)	FUELWOC (tonnes
Residential	84 373		38 187		49
Commercial	1 154				
Industrial					
Government					
Street Lighting					
TOTAL	85 527		38 187		49

1982 ENERGY PROFILE

LOAD CENTER: Mary's Harbour COMMUNITY: Lodge Bay

	ELECTRICITY (GJ)	FURNACE OIL (GJ)	STOVE OIL (GJ)	HEAVY FUEL OIL (GJ)	FUELWOOD (GJ)	TOTAL (GJ)
Residential	304		1 439		4 012	5 755
Commercial	4					4
Industrial						
Government						
Street Lighting						
TOTAL	308		1 439		4 012	5 759

APPENDIX E

- Cost and Cash Flows

CAPITAL BUDGET PROPOSAL

Prepared by: E.G.P. & D.E.H. — Capital Cost Estimate & Cash Flow Requirements — Mary's Harbour Mini Hydro Development Case I

Approved by: — Escln % 83/84= 6.79 — Fiscal Year 84/85= 7.86 — : Prepared: 85/86= 7.85 — 83-11-28 86/87= 8.24

PERIOD	Site Dvlpmt	Dam	Intake	Fish -way	Pen -stock	Purhse & tirce	Trans. & S.T.	Mgmt. & Eng	Corp. O/H	Cont	Sub Total	Escln	I.D.C.	Total Proj.	Cash Flow +
1984 May	0	0	0	0	0	0	0	5	0	1	6	0	0	6	6
Jun	0	0	0	0	0	0	0	10	0	1	11	1	0	12	11
Jul	0	0	0	0	0	0	0	20	1	2	23	2	0	25	23
Aug	0	0	0	0	0	0	0	20	1	2	23	2	1	25	23
Sep	0	0	0	0	0	0	0	15	1	2	17	2	1	20	17
Oct	0	0	0	0	0	0	0	15	1	2	17	2	1	20	17
Nov	0	0	0	0	0	0	0	15	1	2	17	2	1	20	17
Dec	0	0	0	0	0	63	0	15	4	8	90	10	1	101	17
Total 1984	0	0	0	0	0	63	0	115	8	19	205	19	6	230	132
1985 Jan	0	0	0	0	0	0	0	6	0	1	7	1	2	10	79
Feb	0	0	0	0	0	0	0	6	0	1	7	1	3	10	7
Mar	0	0	0	0	0	63	0	6	3	7	79	10	3	92	7
Apr	0	0	0	0	0	0	0	6	0	1	7	1	3	11	79
May	0	0	0	0	0	0	0	6	0	1	7	1	4	12	7
Jun	58	-12	0	0	15	63	0	18	7	17	191	29	4	224	21
Jul	25	95	0	0	66	20	0	38	11	25	288	45	5	338	197
Aug	14	164	60	0	185	53	150	38	26	61	671	111	8	791	240
Sep	32	164	41	53	41	113	0	38	22	58	554	96	12	663	458
Oct	0	152	0	107	38	34	0	38	16	38	415	75	20	510	735
Nov	0	0	0	0	0	0	0	19	1	2	22	4	27	53	410
Dec	0	0	0	0	0	64	0	0	3	7	74	14	0	88	147
Total 1985	129	587	101	160	257	410	150	219	91	210	2,314	389	91	2,794	2,386
Total 1986	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Project	129	587	101	160	257	473	150	334	99	229	2,519	408	97	3,024	2,519

Prepared by: E.G.P. & D.E.H.

Approved by:

CAPITAL BUDGET PROPOSAL
Cash Flow Requirements & I.D.C.
1984/85 Fiscal Year : Prepared: 83-11-28
I.D.C. % = 13.5 Mthly Rate = 0.010609

Mary's Harbour
Mini Hydro Development
Case I

PERIOD	Site Devel.	Dam	Intake	Fish -way	Pen -stock	Purhse & trnce	Trans. & S.T.	Mgmt. & Eng	Corp O/H	Cont	Total Dir.	Escln	Total Cash	I.D.C.	Total Proj.
1984 May	0	0	0	0	0	0	0	5	0	1	6	0	6	0	6
Jun	0	0	0	0	0	0	0	10	0	1	11	1	12	0	12
Jul	0	0	0	0	0	0	0	20	1	2	23	2	25	0	25
Aug	0	0	0	0	0	0	0	20	1	2	23	2	25	1	25
Sep	0	0	0	0	0	0	0	15	1	2	17	2	19	1	20
Oct	0	0	0	0	0	0	0	15	1	2	17	2	19	1	20
Nov	0	0	0	0	0	0	0	15	1	2	17	2	19	1	20
Dec	0	0	0	0	0	0	0	15	1	2	17	2	19	1	21
Total 1984	0	0	0	0	0	0	0	115	5	12	132	12	144	6	149
1985 Jan	0	0	0	0	0	63	0	6	3	7	79	9	89	2	91
Feb	0	0	0	0	0	0	0	6	0	1	7	1	8	3	10
Mar	0	0	0	0	0	0	0	6	0	1	7	1	8	3	10
Apr	0	0	0	0	0	63	0	6	3	7	79	11	90	3	93
May	0	0	0	0	0	0	0	6	0	1	7	1	8	4	12
Jun	0	0	0	0	0	0	0	18	1	2	21	3	24	4	28
Jul	58	12	0	0	0	63	0	38	8	18	197	31	228	5	233
Aug	25	95	0	0	51	0	0	38	9	22	240	40	280	8	288
Sep	14	164	68	0	102	28	0	38	18	42	458	80	537	12	550
Oct	32	164	41	53	45	116	150	38	29	67	735	133	867	20	887
Nov	0	152	0	107	29	58	0	19	16	37	418	70	488	27	515
Dec	0	0	0	0	38	98	0	0	6	13	147	10	157	0	157
Total 1985	129	587	101	160	257	473	150	219	93	217	2,386	397	2,783	91	2,875
Total 1986	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Project	129	587	101	160	257	473	150	334	99	229	2,519	488	2,927	97	3,024

CAPITAL BUDGET PROPOSAL

Prepared by: E.G.P. & D.E.H. — Capital Cost Estimate & Cash Flow Requirements — Mary's Harbour Mini Hydro Development Case II

Approved by: — Fiscal Year : Prepared: 83-11-28

					1984/85	84/85=	85/86=	86/87=						
					6.79	7.86	7.85	8.24						
			Escln %	83/84=										
PERIOD	Site Dvlpmt	Dam	Intake	Fish -way	Pen -stock	Purhse & tirce	Trans. & S.T.	Mgmt. & Eng	Corp. O/H	Cont	Sub Total	Escln	I.D.C.	Total Proj.	Cash Flow
1984 May	0	0	0	0	0	0	0	5	0	1	6	0	0	6	
Jun	0	0	0	0	0	0	0	10	0	1	11	1	0	12	11
Jul	0	0	0	0	0	0	0	15	1	2	17	1	0	19	17
Aug	0	0	0	0	0	0	0	15	1	2	17	1	0	19	17
Sep	0	0	0	0	0	0	0	10	0	1	11	1	1	13	11
Oct	0	0	0	0	0	0	0	10	0	1	11	1	1	13	11
Nov	0	0	0	0	0	0	0	10	0	1	11	1	1	14	11
Dec	0	0	0	0	0	63	0	10	3	8	84	9	1	94	11
Total 1984	0	0	0	0	0	63	0	85	7	15	170	16	4	191	98
1985 Jan	0	0	0	0	0	0	0	5	0	1	6	1	2	9	79
Feb	0	0	0	0	0	0	0	5	0	1	6	1	2	9	6
Mar	0	0	0	0	0	63	0	5	3	7	78	10	2	91	6
Apr	0	0	0	0	0	0	0	5	0	1	6	1	3	9	78
May	0	0	0	0	0	0	0	5	0	1	6	1	3	10	6
Jun	38	10	0	0	8	63	0	17	6	13	147	22	3	173	20
Jul	13	88	0	0	36	28	0	32	8	19	208	33	4	245	109
Aug	7	139	34	0	55	53	150	32	21	49	540	90	6	636	114
Sep	17	139	23	43	22	113	0	32	18	41	447	78	8	533	269
Oct	0	129	0	87	16	34	0	32	13	31	343	62	14	418	615
Nov	0	0	0	0	0	0	0	17	1	2	20	4	20	43	374
Dec	0	0	0	0	0	64	0	0	3	7	74	14	0	88	276
Total 1985	67	497	57	130	137	410	150	187	74	172	1,879	316	67	2,263	1,952
Total 1986	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Total Project	67	497	57	130	137	473	150	272	80	187	2,050	332	72	2,454	2,050

Prepared by: E.G.P. & D.E.H.

Approved by:

CAPITAL BUDGET PROPOSAL
Cash Flow Requirements & I.D.C.
1984/85 Fiscal Year : Prepared: 83-11-28
I.D.C. % = 0.135888 Mthly Rate = 0.010489

Mary's Harbour
Mini Hydro Development
Case II

PERIOD	Site Devel.	Dam	Intake	Fish -way	Pen -stock	Purbse & tirce	Trans. & S.T.	Mgmt. & Eng	Corp O/H	Cont	Total Dir.	Escln	Total Cash	I.D.C.	Tota Proj
1984 May	0	0	0	0	0	6	0	5	0	1	6	0	6	0	
Jun	0	0	0	0	0	0	0	10	0	1	11	1	12	0	1
Jul	0	0	0	0	0	0	0	15	1	2	17	1	19	0	1
Aug	0	0	0	0	0	0	0	15	1	2	17	1	19	0	1
Sep	0	0	0	0	0	0	0	10	0	1	11	1	13	1	1
Oct	0	0	0	0	0	0	0	10	0	1	11	1	13	1	1
Nov	0	0	0	0	0	0	0	10	0	1	11	1	13	1	1
Dec	0	0	0	0	0	0	0	10	0	1	11	1	13	1	1
Total 1984	0	0	0	0	0	0	0	85	4	9	98	0	106	4	11
1985 Jan	0	0	0	0	0	63	0	5	3	7	78	9	87	2	8
Feb	0	0	0	0	0	0	0	5	0	1	6	1	6	2	
Mar	0	0	0	0	0	0	0	5	0	1	6	1	6	2	
Apr	0	0	0	0	0	63	0	5	3	7	78	11	89	3	9
May	0	0	0	0	0	0	0	5	0	1	6	1	7	3	1
Jun	0	0	0	0	0	0	0	17	1	2	20	3	23	3	2
Jul	0	0	0	0	0	63	0	32	4	10	109	17	127	4	13
Aug	38	10	0	0	27	0	0	32	4	10	114	19	133	6	13
Sep	13	88	34	0	55	28	0	32	11	25	269	47	316	8	32
Oct	7	139	23	43	25	116	150	32	24	56	615	111	726	14	74
Nov	17	139	0	87	15	58	0	17	15	34	374	71	444	20	46
Dec	0	129	0	0	15	98	0	0	11	25	278	34	312	0	31
Total 1985	67	497	57	130	137	473	150	187	76	178	1,952	324	2,276	67	2,34
Total 1986	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Total Project	67	497	57	130	137	473	150	272	80	187	2,050	332	2,382	72	2,45

APPENDIX F

- An Environmental Overview of the
Proposed St. Mary's River
Mini-Hydro Development

AN ENVIRONMENTAL OVERVIEW OF THE PROPOSED

ST. MARY'S RIVER MINI-HYDRO DEVELOPMENT

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1.0 INTRODUCTION

The purpose of this report is to review resource conflicts in association with the proposed St. Mary's River mini-hydro development. This exercise has involved some literature review, but owing to the paucity of pertinent literature, it has been based primarily on interviews and discussions with various resource agencies and members of the scientific community.

An assessment of the natural resources is presented, and where possible, mitigation of potential impacts is proposed. The need for additional environmental study is considered, and requirements for registration under the Environmental Assessment Act are reviewed.

2.0 SCOPE OF DEVELOPMENT

The proposed development is located approximately one km west of the coastal community of Mary's Harbour, Labrador, 55^{o} 52' W, 52^{o} 18' N (Figure 1). The project will involve the construction of a number of civil works including:

(1) a concrete overflow dam and fish ladder,
(2) an intake structure,
(3) a penstock,
(4) a 280 kW powerhouse,
(5) an access road, and
(6) a 12.5 kV transmission line.

The concrete overflow dam will be located at the top of White Rock Falls. It will be 3 m in height, and will raise the level of the small upstream pond from 14 m to 17 m asl. At present, the pond is 2.55 ha in area. At the full supply level of 17 m, the reservoir will be 3.11 ha larger, extended to a total area of 5.66 ha. Under maximum flood conditions (1 in 100 year), the reservoir area will be 6.85 ha. A fish ladder over the dam has been proposed for the north side of the existing river channel.

The intake structure will be constructed on the north side of the river. A penstock, 1.2 m in diameter, will carry water 240 m downstream to the powerhouse. Its maximum rated flow capacity is 3.8 m^3 sec^{-1}. The powerhouse will contain a 280 kW turbine and generator, operating under a minimum head of 10.0 m.

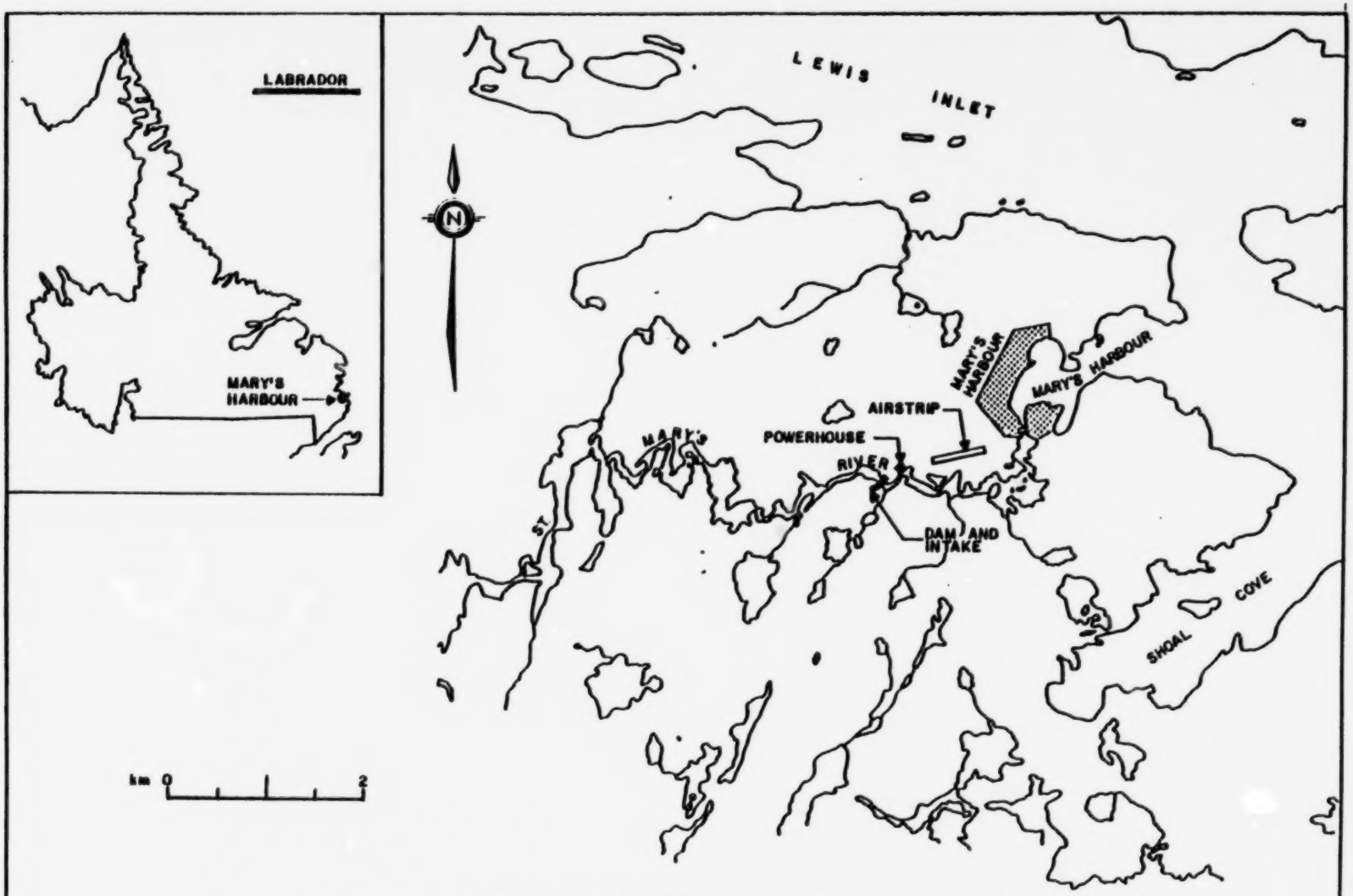

FIGURE 1. LOCATION OF PROPOSED ST. MARY'S RIVER MINI – HYDRO

An access road, 1.1 km in length, will be constructed to link the site with the community of Mary's Harbour. A 12.5 kV transmission line will be constructed in the same right of way interconnecting with the existing community power grid.

It is proposed that this project would be completed in one construction season. The earliest possible completion date of the project would be late 1985.

3.0 ENVIRONMENTAL SETTING

3.1 Physical Setting

3.1.1 Climate

Banfield (1981) included Mary's Harbour in his Coastal Labrador climatic zone. The climate of this area is less continental than the interior, with more frequent storms and stronger winds. Annual precipitation is approximately 1300 mm with a maximum in winter. Between 300 mm and 400 mm of the total annual precipitation falls as snow. Summers can be very warm during offshore southwesterly flows, but cold with onshore circulations. Mean daily temperatures in February, April, July, and October, are $-12^{o}C$, $-1^{o}C$, $12^{o}C$, and $4^{o}C$, respectively.

3.1.2 Geology

Ricketts and Bragg (pers. comm.) have recently conducted an aggregate survey of the areas surrounding coastal Labrador communities. The bedrock geology of the proposed development area is granitic, and is composed primarily of massive white micaceous granite and granitic gneiss. Bedrock outcrop is common. They also emphasized the distinct lack of substantial glacial deposits. The surficial geology is composed of a very thin, discontinuous cover of till of glacial origin. This till predates late Wisconsin glaciation, at which time this area was apparently ice-free (Rogerson, 1983).

The physiography of the area is predominated by large scale streamlined bedrock features, products of extensive glacial erosion. Relief in the development area is between 0 and 40 m asl.

3.1.3 Hydrology

The St. Mary's River drainage area is 473 km^2. Monthly and annual discharge data are not available. However, data have been transposed from the Eagle River, the nearest gauged river with a long term record (1966-1982). Mean annual flow is estimated to be 11.7 m^3 $sec.^{-1}$ (Table 3.1). Mean monthly flows range from a low of 1.7 m^3 $sec.^{-1}$ in March, to 42.8 m^3 $sec.^{-1}$ in June during snowmelt runoff.

Of particular relevance to the discussion of the migration of anadramous salmonids noted in Section 3.2.3, the lowest minimum daily discharges have been determined for 1973, the driest year on record. In the months of July through October, the lowest minimum daily discharge was 8.0, 3.6, 2.9 and 3.4 m^3 $sec.,^{-1}$ respectively,

3.2 Biotic Environment

3.2.1 Vegetation

Wilton (1965) recognized the rapid changes in forest vegetation in the coastal regions of southeastern Labrador. Within 5 km of the coast, there is a transition from coastal barrens, through the scrub and sub-marginal forest zone, fair and marginal forest zone, to the good boreal forest zone. The proposed development site is located in the fair and marginal forest zone. However, in 1959, an extensive forest fire decimated these existing forests. There is a very small remnant stand of black spruce (Picea mariana) and balsam fir (Abies balsamea) on the north side of the proposed reservoir. These are widely spaced and small in diameter, and are for the most part, less than 8 m in height. The remainder of the local area is a burnt over soil and rock barren, with no forest regeneration apparent. Vegetation here is typical of heathlands in the area, primarily mosses, lichens and ericaceous shrubs.

TABLE 3.1 Synthesized Monthly and Annual Discharge for the St. Mary's River (m^3 sec^{-1})

January	2.5
February	2.0
March	1.7
April	2.8
May	28.8
June	42.8
July	14.6
August	11.4
September	9.9
October	12.0
November	7.7
December	3.9
Mean	11.7

3.2.2. Wildlife

Terrestrial wildlife resources are extremely limited in the proposed project area because of habitat restrictions and heavy hunting pressure from the nearby community (Luttich, pers. comm.). Few, if any, big game or furbearing animals would be found in the immediate project area. The status of small mammal populations is not known and is not considered to be important for this project.

Waterfowl resources are also considered limited in this area (Goudie, pers. comm.). Nesting densities of ducks of 2-3 pairs/km^2 are found in this part of Labrador. Given the small size of the proposed development and its proximity to Mary's Harbour, it is unlikely that many, if any, nesting birds would be impacted. There may be some staging of ducks and Canada geese (Branta canadensis) in Spring and Fall in the project area. However, little concern has been expressed regarding potential disturbance of this activity. Clarke (pers. comm.) has reported sightings of as many as 20 Canada geese in the river section immediately upstream of the community, but more than 1 km downstream of the proposed dam. There have been occassional sightings of various species of ducks. In all cases, these have been restricted to staging during the Spring and Fall. He also reported that the RCMP have undertaken covert surveillance of illegal hunting in this area.

3.2.3 Fish

Fish appear to be the most significant biotic resource in the proposed development area. There are three anadramous salmonid species using the river: Atlantic salmon (Salmo salar), Arctic char (Salvelinus alpinus), and brook trout (Salvelinus fontinalis). All of these,

apparently,pass through the study area to spawn in the headwaters of the drainage basin. McCubbin (pers. comm.) reported that Atlantic salmon is the dominant species, whereas Clarke (pers. comm.) estimated the brook trout population to be three times that of the Atlantic Salmon.

Anderson (1983) estimated, on the basis of available rearing habitat and typical sea survival and exploitation rates, that the total Atlantic salmon run in this river could be between 2,700 - 4,000 fish, primarily of grilse size. He reported that at one salmon per rod day, the St. Mary's River had the highest Atlantic Salmon angling success rate of any river in Labrador during the late 1960's. However, this figure may have been a reflection of underutilization relative to other major sports fishing rivers at that time. Anderson (1983) recognized that this angling success rate has diminished in recent years (Table 3.2) as reported by Clarke (pers. comm.). While rod days are not available for 1979-1981, angling success has diminished to 0.31 and 0.26 salmon per rod day in 1982 and 1983, respectively.

Anderson (1983) reported investigations of brook trout populations by the Department of Fisheries and Oceans (DFO) in the late 1960's. On one occassion, a total of 145 anadramous brook trout were angled in four hours using 10 rods. In support of his contention that anadramous brook trout populations are substantially greater than Atlantic salmon, Clarke (pers. comm) reported that approximately 500 brook trout are angled annually. It is important to recognize that the St. Mary's River is a scheduled River in which only fly fishing is permitted. Clarke (pers. comm.) reported that anglers do not fish above the White Rock Falls. Angling effort is quite low relative to the potential anadramous salmonid run, and as a consequence, success is relatively high.

TABLE 3.2 Angling Effort and Success, St. Mary's River (1979-1983)

	Grilse	Salmon	Rod Days	Salmon/rod day Success Rate	Comments
1979	166	2	-	-	-
1980	54	0	-	-	high flows
1981	200*	0	-	-	-
1982	88	0	283	0.31	moderate to high flows
1983	70	0	268	0.26	high to very high flows.

* Estimated, no guardians in river in 1981, and officer reported that poaching had been extensive.

Both McCubbin (pers. comm.) and Clarke (pers. comm.) reported that Arctic char populations are very limited in the St. Mary's River, primarily because the area is near the southern limit of their natural range. Despite this, Clarke (pers. comm.) reported that in the last two years, there is an apparent increase in the incidental catch of Arctic char in salmon nets near the mouth of the river.

McCubbin (pers. comm.) reported that there is no spawning and little if any rearing habitat downstream of the proposed dam site. All anadramous salmonids utilize the spawning habitat which is located in the headwaters of the drainage basin. White Rock Falls do represent a major obstacle to upstream migration. The falls are divided into two sections, a major falls in the center of the river, some four to five m in height, and a smaller less precipitous channel on the north side of the river, with a series of rapids and small falls, all less than 1.5 m in height. Clarke (pers. comm.) estimated that approximately 85 per cent of Atlantic salmon utilize the smaller channel, whereas the remaining 15 per cent can get over the main falls, especially during lower flow conditions. He suggested that trout and char all make use of the side channel.

According to Anderson (1983), the major run of Atlantic Salmon occurs between July 15 and August 31. However, McCubbin (pers. comm.) stated that the run is usually completed by August 15. Spawning would take place in September and October, and perhaps into early November. He felt that Atlantic salmon smolt run to sea at the crest of Spring runoff, usually in June. McCubbin (pers. comm.) was uncertain when kelt (spawned out salmon), return to sea. In some areas, they move back to sea during the winter. Usually however, especially in rivers with such low winter flows, kelt run to sea in the spring with the smolt, overwintering in freshwater lakes and stream pools.

The Arctic char and brook trout runs occur between August 15 and September 30 (McCubbin and Bain, pers. comm.). It is postulated that by September 15, and possibly as early as September 1, the trout and char runs may have actually been completed at White Rock Falls. These fish have to travel 50-100 km upstream to complete their spawning by approximately September 30. Adults move back to sea at the same time as salmon smolt and kelts.

3.3 Human Environment

3.3.1 Historic Resources

Sproull-Thompson (pers. comm.) reported that there are no known archaeological sites in the development area. However, given the location and resources available, she postulated that there was pqtential for an archaeological site, although she did not feel that this was great.

3.3.2 Socioeconomic Considerations

The socioeconomic aspects of the proposed development have not been considered in this report.

3.3.3 Recreation

While recreation and aesthetics may be a nebulous topic, there is a picnic site with four picnic tables at White Rock Falls. According to Clarke (pers. comm.), the area receives relatively intensive use by local residents. The natural beauty of the site is certainly noteworthy, and is a tangible natural resource.

4.0 IMPACTS

4.1 Reservoir

The creation of the reservoir will result in the flooding and loss of 3.11 ha of land at full supply level. Approximately 1.0 ha of this area is a marginal forest stand of black spruce and balsam fir. The remaining flooded area is primarily a soil and rock barren created by the 1959 fire.

4.2 Wildlife

There may be some very minor habitat loss for small mammals such as snowshoe hares, but this is not thought to be significant. There may be some impact of construction on migratory birds, but again, it is thought that this would be minimal.

4.3 Fish

4.3.1 Fish Passage

The major potential impact of this proposed development is its effect on the migration of anadramous salmonids. The construction of a dam three m in height would effectively block upstream migration and may impede downstream movement of kelts and smolt. A fishway is a recognized necessity for ensuring fish passage. Details of this proposed mitigation are discussed in Section 5.2.

4.3.2 Future Flow Regime

A further major impact upon the fish populations is associated with the use of a portion of the river flow in the powerhouse. A maximum of 3.8 m^3 sec^{-1} of water will be diverted from the reservoir, via the penstock, and released back into the river from the powerhouse, approximately 300 m downstream of the dam. The flow requirements for this project are such that the greatest energy production will be in winter, when river flows are low. It is probable that in December through April, on average, all water entering the reservoir will be used to generate power, with little or no overflow spillage at the dam. For long periods in Winter and early Spring, the river section between the dam and powerhouse will be dewatered or could experience severely reduced flow conditions. If it is assumed that the plant could be operating at its full capacity of 3.8 m^3 sec^{-1} (Table 4.1), and given that there is apparently little or no spawning or rearing habitat in this river section and that this period does not coincide with the periods of migration, the impact of such dewatering or flow reduction is not considered to be significant. For the remaining months of the year, on average, flows exceed the maximum turbine flow capacity, resulting in substantial spillage (Table 4.1).

The movement of adult and immature anadramous salmonids should not be impacted detrimentally by the future flow regime. It can be shown that even during 1973 and 1975,the driest years on record, there would still have been spillage over the crest of the dam. Table 4.2 summarizes the estimated minimum daily flows during the Summer and Fall dry season period, July through October, 1973 and 1975. The flows are related to plant flow requirements projected for the year 2003. Even under these extreme minimum flows, there would be some spillage at all times, with a substantial amount most of the time. From this it is concluded

TABLE 4.1 Average Spill Requirements Assuming Maximum Turbine Flow

	Mean Monthly Flow (MMF) (m^3 sec^{-1})	Average Spill* (m^3 sec^{-1})	Average Spill as percentage of MMF
January	2.5	0.0	0
February	2.0	0.0	0
March	1.7	0.0	0
April	2.8	0.0	0
May	28.8	25.0	87
June	42.8	39.0	91
July	14.6	10.8	74
August	11.4	7.6	67
September	9.9	6.1	62
October	12.0	8.2	68
November	7.7	3.9	51
December	3.9	0.1	3

* Assuming maximum turbine flow of 3.8 m^3 $sec.^{-1}$.

TABLE 4.2 Minimum Daily Flow Conditions, July - October, 1973 and 1975, and Projected Plant Requirements in the Year 2003.

Month	Minimum Daily Flow (m^3 sec^{-1})		Projected Plant Requirements In The Year 2003 (m^3 sec^{-1})
	1973	1975	
July	8.0	5.5	2.0
August	3.6	6.4	1.9
September	2.9	6.1	2.4
October	3.4	5.0	2.7

that during the worst possible conditions, the river between the dam and powerhouse will not be dewatered during the critical Summer migration period. On average, flows will be more than adequate to maintain transportation from May through December.

4.3.3. Construction

The impact of construction on fish populations could be severe. While there is little or no spawning habitat downstream, siltation may severely hamper the upstream movement of spawners, and possibly cause physical stress (gill abrasion, etc.). Dewatering activities and diversions associated with the construction of the dam may shift or alter flows over White Rock Falls, such that upstream migration of spawners is delayed, restricted, or perhaps even prevented.

4.3.4 Poaching and Other Fish Ladder Concerns

A creation of a fish ladder may result in increased poaching during the spawning run (Goosney, pers. comm.).

Fish ladders are not always entirely successful, and often, for unknown reasons, fish will refuse to, or make limited use of a man made structure. The extent or potential of this impact is not known.

4.3.5 Entrainment at Intake and Tailrace

It is possible that salmon smolt, and their counterpart in trout and char, will be entrained into the intake and penstock during their seaward migration in Spring. This could result in mortalities in the turbine.

It is possible that during the upstream migration of salmonids, they may be attracted by the force and flow of the powerhouse tailrace. This could delay and confuse the fish, but it is felt that this impact would not seriously affect their upstream migration. The tailrace flow will be, on average, substantially less than the flow which is spilled over the dam.

4.4 Historic Resources

Given the potential for archaeological resources in this area, there is some possibility that the proposed civil works may disturb, alter or destroy an archaeological site. The probability of such an impact cannot be estimated without a survey of the area.

4.5 Loss of Land

In addition to the creation of the reservoir (Section 4.1), it is predicted that approximately 2.0 ha of land will be lost to road construction, quarrying, transmission line right-of-way, penstock right-of-way, intake and powerhouse installations, and the creation of laydown and equipment storage areas. This impact is non-mitigatable.

4.6 Recreation

The construction of the dam, fishway, and intake structure may negatively affect the aesthetic value of the falls and its environs, especially during times of low spillage. Despite this, the overflow dam and fish ladder may present some positive aesthetic value under normal flow conditions. We have not yet ascertained if these structures will actually impinge upon the picnic area itself. Further to this, the visual impact of partially flooded trees on the north side of the reservoir may negatively affect its aesthetic character.

5.0 MITIGATION

5.1 Reservoir Clearing

For aesthetic reasons, it is recommended that the future reservoir perimeter be cleared of all trees to a height of one m above full supply level (14-18 m asl). This will enhance the future aesthetic value of the location, and remove the negative visual impact of a partly inundated forest.

5.2 Fish Passage

As noted in Section 4.3.1, it will be necessary to construct a fish ladder to ensure unimpeded upstream migration of anadramous salmonids. Goosney (pers. comm.) suggested that DFO would be satisfied with a vertical slot fish ladder, 3 m in height with 0.3 m increments, to provide passage over the dam. This ladder would be located between the top of the falls in the existing north side channel and the crest of the dam. The ladder must have a 1.5 m deep pool below the first increment, and each successive pool must be 1.8 x 2.4 m, and 1.5 m deep. The fish ladder configuration must be such that the natural movement of fish up the north side channel remains unimpeded.

Goosney and McCubbin (pers. comm.) recommended a minimum maintenance flow through the fishway of 0.43 to 0.57 m^3 sec^{-1}. They expressed concern that this flow may be insufficient to maintain natural flow in the north side channel. It may be necessary to release additional flow into the lowest pool of the fish ladder to supplement flows below the fishway in the natural north side channel. This could be achieved by enhanced spillage over the dam in the immediate vicinity of the pool, or by means of a water release pipe.

Before Hydro could design this water release, detailed surveys, hydrological field work, and hydrological modelling would be required to determine the natural flow regime of the north side channel during fish migration. Flow partitioning between the main falls and north side channel would have to be rated against discharge.

In order to restrict potential poaching of migrating fish from the fish ladder, Goosney (pers. comm.) has recommended that a protective steel grating be installed over it. As well, he noted that a reduction in the flow regime of the north side channel might result in enhanced illegal fishing opportunities. To mitigate this, it may be necessary to similarly protect this natural channel with steel grating.

Goosney (pers. comm.) noted that any reduction in the future flow regime may create a migratory barrier at the downstream entrance to the north side channel. To mitigate this, it may become necessary to undertake a remedial controlled blasting program to eliminate these restrictive barriers.

To mitigate the potential smolt entrainment problem at the intake, Goosney (pers. comm.) suggested locating the intake at least 8-10 m away from the fish ladder upstream exit. Further to this, he noted that DFO normally require a smolt screen over the intake during their downstream migration, usually during May and June.

McCubbin and Goosney (pers. comm.) have stated that it will be necessary to ensure fish passage. This will involve the monitoring of the success of the fish ladder after it has been constructed. The cost of such a study should be minimal, but may translate into the requirement for additional mitigation and/or monitoring. As a part of this study, it may be necessary to monitor smolt entrainment at the intake, as well as the attraction of fish to the tailrace during upstream migration.

5.3 Historic Resources

It will be necessary to conduct an archaeological field reconnaissance of the area to determine whether any archaeological sites are present. If there are sites discovered, it may be necessary to carry out further study.

5.4 Construction Practices

In general, it will be necessary for Hydro to follow sound environmental construction practices as outlined in its standard contract document environmental protection clauses. Furthermore, it will be necessary to obtain permits under,and comply with,all laws and regulations.

5.4.1 Clearing

As a basic goal, Hydro should restrict its clearing and use of land to only that which is absolutely necessary. This would involve the use of minimum rights-of-way and clearing limits. Route selection for the road, transmission line, and penstock should be compatible with the natural resources and aesthetic beauty of the area. A tree screen and buffer zone should be maintained between the picnic area and the nearby intake and penstock.

5.4.2 Dewatering, Diversion, and Instream Work

During dewatering and diversion activities associated with construction of the civil works, it will be necessary to adopt the axiom that under no circumstances, will fish be impeded in their upstream migration between July 15 and September 30. All instream work will be subject to DFO and

Department of Environment permits. McCubbin (pers. comm.) has stated that it may be necessary to cease all instream work during a two week period, the last week of July and the first week in August, the period of peak upstream migration of salmon. However, given the salmon run is usually almost complete by August 15th, and that the trout and char run past White Rock Falls may be complete as early as September 15, it may be feasible to reduce this restriction from September 30 to September 15. McCubbin (pers. comm.) has indicated that DFO would entertain such a proposal in light of the timing of the Atlantic salmon run, and being cognizant of the difficulty in completing the project within one construction season.

5.5 Public Relations

Vanderveer (pers. comm.) has indicated that it would be a positive mitigation to advise the community council of Mary's Harbour of our intentions, well in advance of mobilization. This would enable the community to budget for the stockpiling of aggregates for community needs without paying for contractor mobilization fees.

Furthermore, it must be recognized that the possible degradation of the aesthetic value of the picnic area should be addressed publicly and involve public consent.

6.0 REGISTRATION AND ASSESSMENT

This project should be registered under the Environmental Assessment Act as soon as it is approved. Preparation of the registration will require 10 working days. When registered, the Department of Environment requires 30 working days (1.4 months) to review the registration and decide if the project may proceed, or if an Environmental Preview Report (EPR) or Environmental Impact Statement (EIS) is required. It is anticipated that given the proposed mitigation, the project would be allowed to proceed without an EPR or EIS. However, if this assumption should prove incorrect, the timetable of governmental deliberations is summarized in Table 6.1. This does not include the time required for studies which would have to be carried out, or the preparation of an EPR or EIS. As an example, a fish population study, if required, would be carried out between July 15 and August 31, effectively delaying construction by at least one construction season.

TABLE 6.1

TIME REQUIREMENTS FOR GOVERNMENTAL DELIBERATIONS

ON ENVIRONMENTAL ASSESSMENTS*

Process Phase	Days		Equivalent in Months
	Work	Calendar	
1. Registration	30		1.4
2. EPR	25		1.2
3. EIS Terms of Reference	30		1.4
4. EIS	45		2.1
5. Environmental Assessment Board Hearings			
a) Recommendation to Cabinet that a Board be established.		15	0.5
b) Board appointed.		30	1.0
c) Announcement of appointment	5		0.2
d) Public hearings start		60-90	1.0-2.0
*e) Public hearings	-		-
f) Report submission		45	1.5
6. Ministerial recommendation to cabinet.	15		0.7
7. Cabinet decision		30-60	1.0-2.0

*Exclusive of the time required by a proponent to prepare environmental assessment documents, any requirement by the Minister of Environment for a proponent to repeat any phase of the process, and of the time required for Public Hearings.

7.0 REFERENCES

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Anderson, T.C. 1983 (in preparation). The Rivers of Labrador. Technical Report, Fisheries and Oceans Canada, St. John's.

8.0 PERSONAL COMMUNICATIONS

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McCubbin, R. Technician, Habitat Research and Assessment Section, Fisheries and Oceans Canada, St. John's.

Bain, H. Acting Head, Habitat Protection and Assessment Program, Fisheries and Oceans Canada, St. John's

Sproull-Thompson, J. Curator of Archaeology/Ethnology, Historic Resources Division, Department of Culture, Recreation, and Youth, Government of Newfoundland and Labrador, St. John's.

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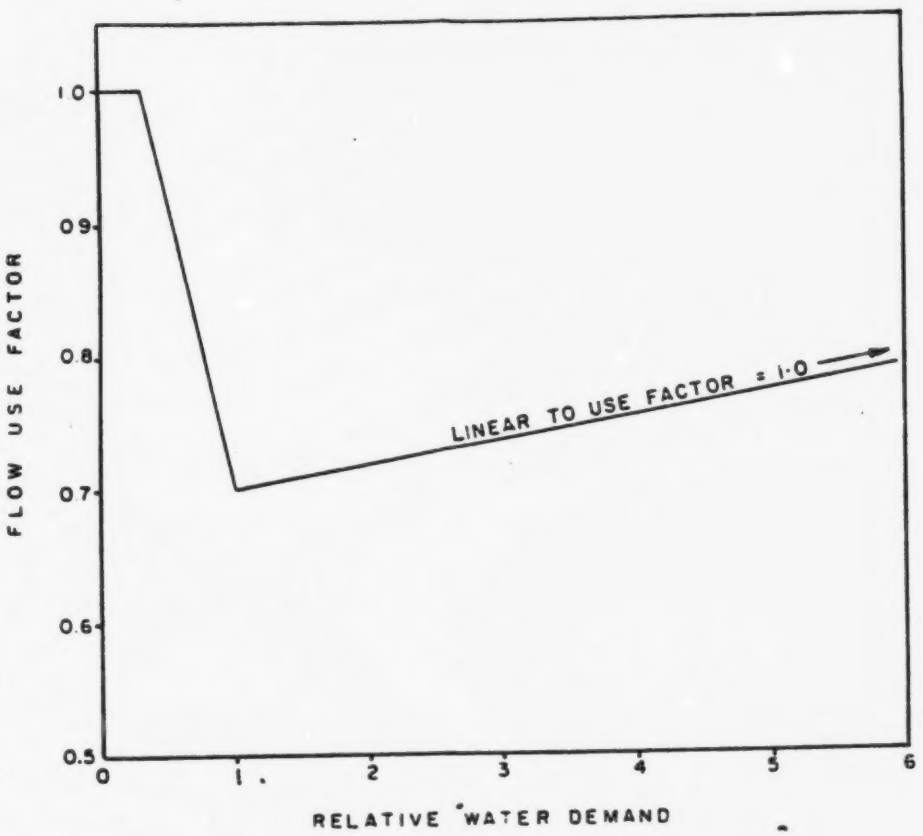
Vanderveer, D. Senior Geologist, Environmental Geology Section, Department of Mines and Energy, Government of Newfoundland and Labrador, St. John's.

APPENDIX G

Flow and Load Use Factors

FIGURE 4 – 2



NOTES:

1) FLOW USE FACTOR = $\frac{\text{ENERGY GENERATED (ACTUAL FLOW, CONSTANT LOAD)}}{\text{ENERGY GENERATED (CONSTANT FLOW, CONSTANT LOAD)}}$

2) RELATIVE WATER DEMAND = $\frac{\text{WATER REQUIRED}}{\text{WATER AVAILABLE}}$

NEWFOUNDLAND & LABRADOR HYDRO

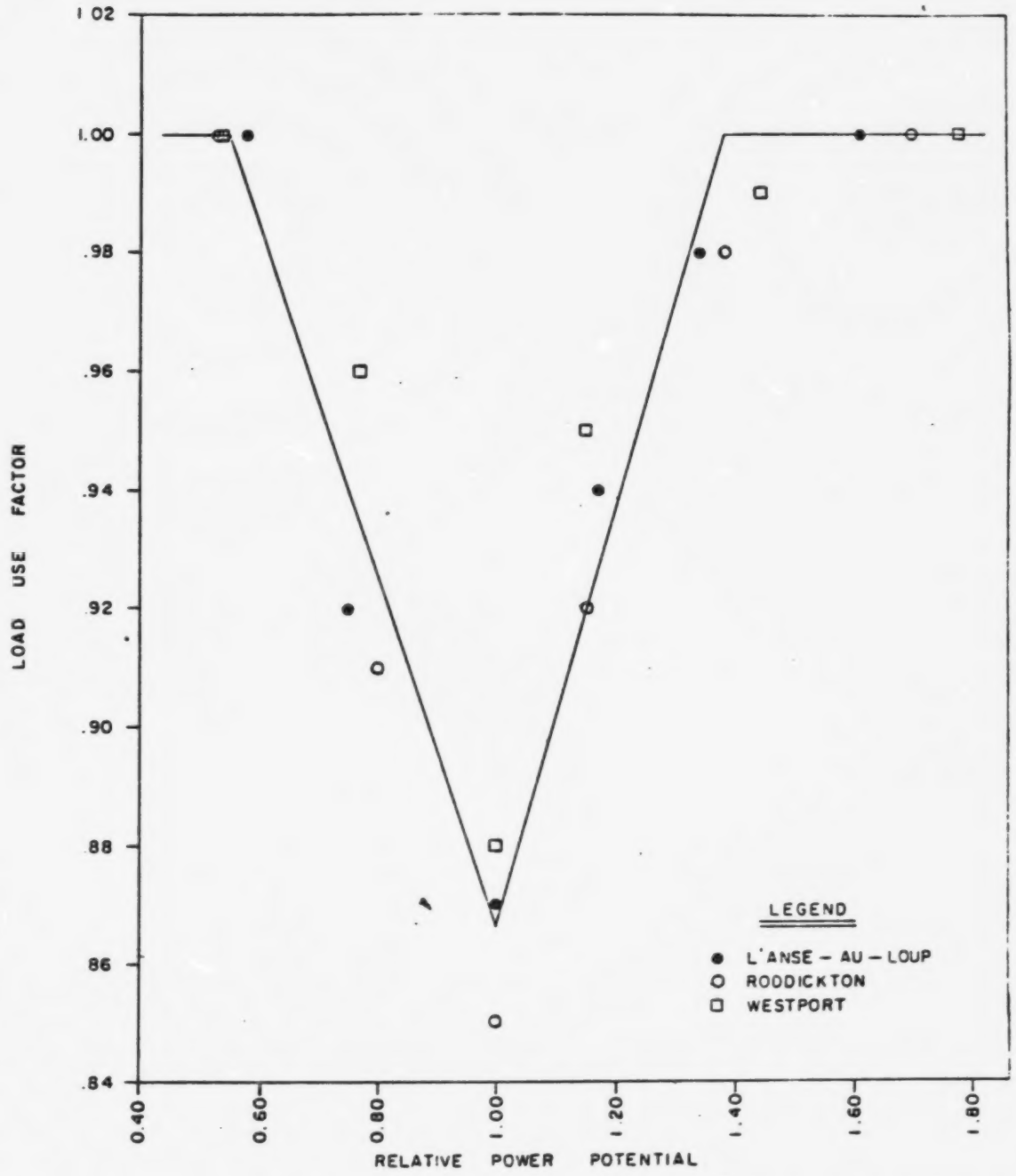
SMALL SCALE HYDRO STUDY

SHAWMONT NEWFOUNDLAND LIMITED

FLOW USE CURVE

DESIGNED	DRAWN R.J.K	SCALE	DATE MAR., 1979
CONTRACT 479	FILE NO		APPROVED

FIGURE 4-5



NOTES:

1) RELATIVE POWER POTENTIAL = $\frac{\text{PLANT CAPABILITY}}{\text{AVERAGE LOAD}}$

2) LOAD USE FACTOR = $\frac{\text{ENERGY GENERATED (ACTUAL LOAD, CONSTANT FLOW)}}{\text{ENERGY GENERATED (CONSTANT LOAD, CONSTANT FLOW)}}$

NEWFOUNDLAND & LABRADOR HYDRO

SMALL SCALE HYDRO STUDY

SHAWMONT NEWFOUNDLAND LIMITED

LOAD USE CURVE

DESIGNED	DRAWN TK THORNE	SCALE	DATE JAN 79
CONTRACT 1679	FILE NO		APPROVED

APPENDIX H

- Cost Effectiveness Analysis
Cost Projections for
Cases 1 - 7

DSLI - TABLE 3 OF 4

HARYS HARBOUR DIESEL PLANT COST PROJECTIONS

YEAR	DIESEL KWH (X1000)	FUEL(LIT.) (X1000)	FUEL COST ($X1000)	FUEL+LUBE COST ($X1000)	O & M COST DIESEL FIXED ($X1000)	O & M COST DIESEL VARIABLE ($X1000)	O & M COST DIESEL TOTAL ($X1000)
1983	1003.0	385.8	160.9	164.3	105.4	24.3	129.7
1984	1067.0	410.4	170.2	170.9	110.8	27.2	138.0
1985	1164.0	447.2	203.7	208.1	117.3	31.5	148.9
1986	1223.0	470.4	227.1	232.0	124.5	35.0	159.5
1987	1284.0	493.8	259.6	265.1	132.7	39.2	171.9
1988	1314.0	506.9	282.3	288.3	141.6	42.9	184.5
1989	1353.0	520.4	309.5	316.1	149.5	46.5	196.0
1990	1392.0	535.4	335.5	342.6	157.1	50.3	207.4
1991	1435.0	551.9	366.6	373.4	164.8	54.4	219.3
1992	1474.0	566.9	395.3	403.7	172.9	58.6	231.5
1993	1516.0	583.1	430.7	439.8	181.9	63.4	245.3
1994	1546.0	594.6	463.3	473.2	191.3	68.0	259.4
1995	1577.0	606.5	502.0	512.7	201.7	73.2	274.9
1996	1605.0	617.3	537.7	549.1	212.6	78.5	291.1
1997	1630.9	630.0	577.9	590.2	223.8	84.3	308.1
1998	1668.0	641.5	616.8	629.9	234.9	90.1	325.0
1999	1700.0	653.8	661.2	675.3	246.9	96.5	343.4
2000	1733.0	666.5	707.3	722.4	259.7	103.8	363.3
2001	1760.0	680.0	757.2	773.3	273.3	111.1	384.4
2002	1805.0	694.2	811.2	828.5	287.5	119.4	406.9
2003	1839.0	707.3	867.2	885.7	302.5	127.9	430.4
2004	1876.0	721.5	928.3	948.1	318.2	137.3	455.5
2005	1914.0	736.2	993.8	1015.0	334.8	147.4	482.2
2006	1951.0	750.4	1063.0	1085.6	352.2	158.1	510.3
2007	1989.0	765.0	1137.2	1161.4	370.6	169.6	540.2
2008	2029.0	780.4	1217.2	1243.2	389.9	182.0	571.9
2009	2070.0	796.2	1303.1	1330.9	410.2	195.3	605.6
2010	2113.0	812.7	1396.8	1426.5	431.6	209.8	641.4
2011	2154.0	828.5	1493.1	1524.9	454.1	225.0	679.1
2012	2197.0	845.0	1598.0	1632.0	477.7	241.4	719.2
2013	2240.0	861.5	1709.6	1746.1	502.6	259.0	761.6
2014	2287.0	879.6	1831.6	1870.6	528.8	278.2	807.0
2015	2333.0	897.3	1960.6	2002.4	556.4	298.6	854.9

CASE 1

- DIESEL ALTERNATIVE

DSL1 - TABLE 9 OF 9

MARYS HARBOUR DIESEL PLANT COST PROJECTIONS

YEAR	DIESEL PROJECTION INSTAL. KW	DIESEL PROJECTION FIRM KW	LOAD KW	ENERGY MWH	CAPITAL EXPEND. (000)	OPERATIONAL COSTS FUEL & LUBE (000)	OPERATIONAL COSTS SALARIES & MAINT. (000)	TOTAL COST (000)	PRESENT WORTH COST (000)	CUMULATIVE PRESENT WORTH COST (000)
1983	800.0	500.0	347.0	1003.0	0.0	164.3	129.7	294.0	260.2	260.2
1984			369.1	1067.0	0.0	178.9	138.0	316.9	248.2	508.4
1985			404.0	1168.0	0.0	208.1	148.9	356.9	247.4	755.8
1986			423.1	1223.0	0.0	232.0	159.5	391.5	240.1	995.9
1987			444.2	1284.0	0.0	265.1	171.9	437.1	237.2	1233.1
1988			455.9	1318.0	0.0	288.3	184.5	472.7	227.1	1460.2
1989			466.0	1353.0	0.0	316.1	196.0	512.1	217.7	1677.9
1990			481.5	1392.0	0.0	342.6	207.4	550.0	206.5	1884.4
1991			496.4	1435.0	0.0	373.4	219.3	592.6	197.3	2082.0
1992			509.9	1474.0	0.0	403.7	231.5	635.2	187.1	2269.2
1993			524.4	1516.0	0.0	439.8	246.3	686.2	178.6	2447.8
1994			534.8	1546.0	0.0	473.2	259.4	732.6	169.0	2616.8
1995			545.5	1577.0	0.0	512.7	274.9	787.7	160.8	2777.6
1996			555.2	1605.0	0.0	549.1	291.1	840.2	151.8	2929.4
1997			566.0	1638.0	0.0	590.2	308.1	898.3	143.6	3073.0
1998			577.0	1668.0	0.0	629.9	325.0	954.9	135.1	3208.2
1999			588.1	1700.0	0.0	675.3	343.4	1018.7	127.6	3335.7
2000			599.5	1733.0	0.0	722.4	363.3	1085.7	120.3	3456.0
2001			611.0	1768.0	0.0	773.3	384.4	1157.7	113.5	3569.6
2002			624.4	1805.0	0.0	828.5	406.9	1235.3	107.2	3676.8
2003			636.2	1839.0	0.0	885.7	430.4	1316.1	101.1	3777.9
2004			646.0	1876.0	0.0	948.1	455.5	1403.7	95.4	3873.3
2005			662.1	1914.0	0.0	1015.0	482.2	1497.2	90.0	3963.3
2006			674.9	1951.0	0.0	1085.6	510.4	1596.0	84.9	4048.2
2007			688.0	1989.0	0.0	1161.4	540.2	1701.6	80.1	4128.4
2008			701.9	2029.0	0.0	1243.2	571.9	1815.1	75.7	4204.0
2009			716.1	2070.0	0.0	1330.9	605.6	1936.5	71.4	4275.5
2010			730.9	2113.0	0.0	1425.5	641.4	2066.9	67.5	4342.9
2011			745.1	2154.0	0.0	1524.9	679.1	2203.9	63.7	4406.6
2012			760.0	2197.0	0.0	1632.0	719.2	2351.2	60.1	4466.7
2013			774.9	2240.0	0.0	1746.1	761.6	2507.7	56.7	4523.5
2014			791.1	2287.0	0.0	1870.6	807.0	2677.6	53.6	4577.1
2015			807.0	2333.0	0.0	2002.4	854.9	2857.3	50.6	4627.7

CASE 1

- DIESEL ALTERNATIVE

HYDL - TABLE 3 OF 4

HY-DL MARYS HARBOUR ---- COST PROJECTIONS FOR HYDRO-DIESEL ALTTERNATIVE

YEAR	DIESEL KWH (X1000)	FUEL(LIT.) (X1000)	FUEL COST ($X1000)	FUEL+LUBE COST ($X1000)	O&M COST DIESEL FIXED ($X1000)	O&M COST DIESEL VARIABLE ($X1000)	O&M COST HYDRO FIXED ($X1000)	TOTAL ($X1000)
1983	1003.0	385.8	160.9	164.3	105.4	24.3	0.0	129.7
1984	1067.0	410.4	176.2	178.9	110.8	27.2	0.0	138.0
1985	1166.0	449.2	203.7	208.1	117.3	31.5	0.0	148.9
1986	1.0	61.5	29.7	30.3	124.5	4.6	7.2	136.3
1987	181.0	69.6	36.6	37.4	132.7	5.5	7.7	145.9
1988	194.0	74.6	41.5	42.4	141.6	6.3	8.2	156.1
1989	207.0	79.6	47.4	48.4	149.5	7.1	8.6	165.3
1990	224.0	86.2	54.0	55.1	157.1	8.1	9.1	174.2
1991	241.0	92.7	61.4	62.7	164.8	9.1	9.5	183.5
1992	258.0	99.2	69.2	70.7	172.9	10.3	10.0	193.2
1993	280.0	107.7	79.5	81.2	181.9	11.7	10.5	204.1
1994	298.0	114.6	89.3	91.2	191.3	13.1	11.1	215.5
1995	314.0	120.8	100.0	102.1	201.7	14.6	11.7	228.0
1996	329.0	126.5	110.2	112.6	212.6	16.1	12.3	241.0
1997	350.0	134.6	123.5	126.1	223.8	18.0	12.9	254.7
1998	370.0	142.3	136.8	139.7	234.9	20.0	13.6	268.6
1999	391.0	150.4	152.1	155.3	246.9	22.2	14.3	283.3
2000	414.0	159.2	169.0	172.6	259.7	24.7	15.0	299.5
2001	436.0	167.7	186.3	190.3	273.3	27.3	15.8	316.4
2002	461.0	177.3	207.2	211.6	287.5	30.6	16.6	334.6
2003	483.0	185.8	227.8	232.6	302.5	33.6	17.5	353.6
2004	507.0	195.0	250.9	256.2	318.2	37.1	18.4	373.7
2005	532.0	204.6	276.2	282.1	334.8	41.0	19.4	395.1
2006	558.0	213.8	302.9	309.4	352.2	45.1	20.4	417.7
2007	583.0	224.2	333.3	340.4	370.6	49.7	21.4	441.7
2008	612.0	235.4	367.2	375.0	389.9	54.6	22.5	467.3
2009	640.0	246.2	402.9	411.5	410.2	60.4	23.7	494.3
2010	670.0	257.7	442.6	452.0	431.6	66.5	24.9	523.1
2011	697.0	268.1	483.1	493.4	454.1	72.8	26.2	553.1
2012	727.0	279.6	528.8	540.0	477.7	79.9	27.6	585.2
2013	756.0	290.8	577.0	589.3	502.6	87.4	29.1	619.1
2014	787.0	302.7	630.3	643.7	528.8	95.7	30.6	655.1
2015	818.0	314.6	687.4	702.1	556.4	104.7	32.2	693.2

CASE 1

- HYDRO DIESEL ALTERNATIVE

HYDL - TABLE 4 CF 4

HY-DL MARYS HARBOUR ------- COST PROJECTIONS

YEAR	TOTAL KW INSTALLED	TOTAL KW FIRM	FORECAST KW	FORECAST HYDRO MWH	FORECAST DIESEL MWH	CAPITAL EXPEND. ($X1000)	OPERATIONAL COSTS FUEL+LUBE ($X1000)	OPERATIONAL COSTS TOTAL OEM ($X1000)	TOTAL COST ($X1000)	P.W. COST ($X1000)	CUMUL. P.W. COST ($X1000)
1983	800.0	800.0	347.0	0.0	1003.0	0.0	164.3	129.7	294.0	260.2	260.2
1984			369.1	0.0	1067.0	0.0	178.9	138.0	316.9	248.2	508.4
1985	1080.0	500.0	404.0	0.0	1168.0	3024.0	208.1	148.9	1180.9	2343.2	2851.6
1986			423.1	1063.0	160.0	0.0	30.3	136.3	166.6	102.2	2953.8
1987			444.2	1103.0	181.0	0.0	37.4	145.9	183.3	99.5	3053.3
1988			466.9	1124.0	194.0	0.0	42.4	156.1	198.5	95.3	3148.6
1989			488.0	1146.0	207.0	0.0	48.4	165.3	213.6	90.8	3239.4
1990			481.5	1168.0	224.0	0.0	55.1	174.2	229.4	86.3	3325.7
1991			496.4	1184.0	241.0	0.0	62.7	183.5	246.2	82.0	3407.6
1992			509.9	1216.0	258.0	0.0	70.7	193.2	263.8	77.7	3485.4
1993			524.4	1246.0	269.0	0.0	81.2	204.1	285.4	74.4	3559.8
1994			534.8	1248.0	298.0	0.0	91.2	215.6	306.7	70.8	3630.5
1995			545.5	1263.0	314.0	0.0	102.1	228.0	330.1	67.4	3697.9
1996			555.2	1276.0	329.0	0.0	112.6	241.0	353.6	63.9	3761.8
1997			566.6	1288.0	350.0	0.0	126.1	254.7	380.8	60.9	3822.7
1998			577.0	1298.0	370.0	0.0	139.7	268.5	408.2	57.8	3880.4
1999			588.1	1309.0	391.0	0.0	155.3	283.3	438.7	54.9	3935.4
2000			599.5	1319.0	414.0	0.0	172.6	299.5	472.0	52.3	3987.7
2001			611.6	1331.0	435.0	0.0	190.3	316.4	506.7	49.7	4037.4
2002			624.4	1344.0	461.0	0.0	211.6	334.6	546.2	47.4	4084.8
2003			636.2	1356.0	483.0	0.0	232.6	353.6	586.2	45.0	4129.8
2004			649.0	1369.0	507.0	0.0	256.2	373.7	630.0	42.8	4172.6
2005			662.1	1382.0	532.0	0.0	282.1	395.1	677.2	40.7	4213.3
2006			674.9	1395.0	556.0	0.0	309.4	417.7	727.0	38.7	4252.0
2007			688.0	1406.0	583.0	0.0	340.4	441.7	782.1	36.8	4288.8
2008			701.9	1417.0	612.0	0.0	375.0	467.3	842.3	35.1	4324.0
2009			716.1	1430.0	640.0	0.0	411.5	494.3	905.8	33.4	4357.4
2010			730.9	1443.0	670.0	0.0	452.0	523.1	975.1	31.8	4389.2
2011			745.1	1457.0	697.0	0.0	493.4	553.1	1046.6	30.2	4419.4
2012			760.0	1470.0	727.0	0.0	540.0	585.2	1125.3	28.8	4448.2
2013			774.5	1484.0	756.0	0.0	589.3	619.1	1208.4	27.3	4475.6
2014			791.1	1500.0	787.0	0.0	643.7	655.1	1298.8	26.0	4501.6
2015			807.0	1515.0	818.0	0.0	702.1	693.2	1395.3	24.7	4526.2

CASE 1

- HYDRO DIESEL ALTERNATIVE

HYDL - TABLE 4 OF 4

HY-DL MANYS HARBOUR ------ COST PROJECTIONS

YEAR	TOTAL Kw INSTALLED	TOTAL Kw FIRM	FORECAST Kw	FORECAST HYDRO MWH	FORECAST DIESEL MWH	CAPITAL EXPEND. ($X1000)	OPERATIONAL COSTS FUEL+LUBE ($X1000)	OPERATIONAL COSTS TOTAL OGM ($X1000)	TOTAL COST ($X1000)	P.W. COST ($X1000)	CUMUL. P.W. COST ($X1000)
1984	800.0	500.0	357.0	0.0	1003.0	0.0	144.3	145.7	290.0	280.2	280.2
1985	1080.0	500.0	404.0	0.0	1168.0	2739.0	208.1	148.9	3095.9	2145.6	2425.8
1986			423.1	1063.0	160.0	0.0	30.3	136.3	166.6	102.2	2528.0
1987			444.2	1103.0	181.0	0.0	37.4	145.9	183.3	99.5	2627.5
1988			465.0	1124.0	194.0	0.0	42.4	136.1	178.5	95.3	2722.8
1989			488.0	1146.0	207.0	0.0	48.4	165.3	213.6	90.8	2813.6
1990			481.5	1168.0	224.0	0.0	55.1	174.2	229.4	86.3	2899.9
1991			490.4	1184.0	241.0	0.0	64.7	183.5	248.2	82.0	2981.9
1992			509.9	1210.0	266.0	0.0	70.7	193.2	263.8	77.7	3059.6
1993			524.4	1236.0	280.0	0.0	81.2	204.1	285.4	74.4	3134.0
1994			534.8	1248.0	298.0	0.0	91.2	215.5	306.7	70.8	3204.8
1995			545.8	1263.0	314.0	0.0	102.1	226.0	328.1	67.4	3272.2
1996			558.2	1276.0	325.0	0.0	112.6	241.0	353.6	63.9	3336.1
1997			566.6	1288.0	350.0	0.0	126.1	254.7	380.8	60.9	3397.0
1998			577.0	1298.0	370.0	0.0	139.7	268.8	408.2	57.8	3454.8
1999			588.1	1309.0	391.0	0.0	155.3	284.3	439.7	54.9	3509.7
2000			599.5	1319.0	414.0	0.0	172.6	299.5	472.0	52.3	3562.1
2001			611.0	1333.0	436.0	0.0	190.3	316.4	506.7	49.7	3611.8
2002			624.4	1344.0	461.0	0.0	211.6	334.6	546.2	47.4	3659.2
2003			636.2	1356.0	483.0	0.0	232.4	353.6	586.2	45.0	3704.2
2004			649.0	1369.0	507.0	0.0	256.2	373.7	630.0	42.8	3747.0
2005			662.1	1382.0	532.0	0.0	282.1	395.1	677.2	40.7	3787.8
2006			674.9	1395.0	556.0	0.0	309.4	417.7	727.0	38.7	3826.5
2007			688.0	1406.0	583.0	0.0	340.4	441.7	782.1	36.8	3863.3
2008			701.9	1417.0	612.0	0.0	375.0	467.3	842.3	35.1	3898.4
2009			716.1	1430.0	640.0	0.0	411.5	494.3	905.8	33.4	3931.9
2010			730.9	1443.0	670.0	0.0	452.0	523.1	975.1	31.8	3963.7
2011			745.1	1457.0	697.0	0.0	494.4	553.1	1048.6	30.2	3993.9
2012			760.0	1470.0	727.0	0.0	540.0	585.2	1125.3	28.8	4022.7
2013			774.9	1484.0	756.0	0.0	589.3	619.1	1208.4	27.3	4050.0
2014			791.1	1500.0	787.0	0.0	643.7	655.1	1298.8	26.0	4076.0
2015			807.0	1515.0	818.0	0.0	702.1	693.2	1395.3	24.7	4100.7

CASE 2

- HYDRO DIESEL ALTERNATIVE

HYDRO - TABLE 4 OF 4

HY-DRO MARYS HARBOUR ------ COST PROJECTIONS

YEAR	TOTAL KW INSTALLED	TOTAL KW FIRM	FORECAST KW	FORECAST HYDRO MWH	FORECAST DIESEL MWH	CAPITAL EXPEND. ($X1000)	OPERATIONAL COSTS FUEL+LUBE ($X1000)	OPERATIONAL COSTS TOTAL OEM ($X1000)	TOTAL COST ($X1000)	P.W. COST ($X1000)	CUMUL. P.W. COST ($X1000)
1983	800.0	500.0	347.0	0.0	1003.0	0.0	164.3	129.7	294.0	260.2	260.2
1984			369.1	0.0	1067.0	0.0	178.9	138.0	316.9	248.2	508.4
1985	1080.0	500.0	404.0	0.0	1168.0	2464.0	200.1	140.9	2810.2	1548.1	2056.5
1986			423.1	1003.0	160.0	0.0	30.3	132.3	162.6	102.2	2158.7
1987			444.2	1103.0	181.0	0.0	37.4	146.9	184.3	99.5	2258.2
1988			455.9	1124.0	194.0	0.0	42.4	136.1	178.5	85.3	2343.6
1989			468.0	1146.0	207.0	0.0	48.4	165.3	213.8	90.8	2434.4
1990			481.5	1168.0	224.0	0.0	56.1	174.2	229.4	86.3	2520.6
1991			496.4	1194.0	241.0	0.0	62.7	183.5	246.2	82.0	2602.6
1992			509.9	1216.0	258.0	0.0	70.7	193.2	263.8	77.7	2680.3
1993			524.4	1240.0	280.0	0.0	81.4	203.1	285.4	74.4	2754.7
1994			534.8	1243.0	298.0	0.0	91.2	215.8	307.7	70.8	2825.6
1995			545.5	1263.0	314.0	0.0	102.1	228.0	330.1	67.4	2892.9
1996			555.2	1276.0	329.0	0.0	112.6	241.0	353.6	63.9	2956.7
1997			566.6	1288.0	350.0	0.0	126.1	254.7	380.8	60.3	3017.0
1998			577.0	1298.0	370.0	0.0	139.7	268.5	408.2	57.8	3074.8
1999			588.1	1309.0	391.0	0.0	155.3	283.3	438.7	54.9	3129.7
2000			599.5	1319.0	414.0	0.0	172.8	299.5	472.0	52.3	3182.0
2001			611.6	1333.0	436.0	0.0	190.4	316.4	506.7	49.7	3231.7
2002			624.4	1344.0	461.0	0.0	211.6	334.6	546.2	47.4	3279.1
2003			636.2	1356.0	483.0	0.0	232.6	353.6	586.2	45.0	3324.1
2004			649.0	1369.0	507.0	0.0	256.2	373.7	630.0	42.8	3366.9
2005			662.1	1382.0	532.0	0.0	282.1	395.1	677.2	40.7	3407.6
2006			674.9	1395.0	556.0	0.0	309.4	417.7	727.0	38.7	3446.3
2007			688.0	1408.0	581.0	0.0	340.4	441.7	782.1	36.8	3483.0
2008			701.9	1417.0	612.0	0.0	375.0	467.3	842.3	35.1	3520.5
2009			716.1	1430.0	640.0	0.0	411.5	494.3	905.8	33.4	3553.8
2010			730.9	1443.0	670.0	0.0	452.0	523.1	975.1	31.8	3585.6
2011			745.1	1457.0	697.0	0.0	493.4	553.1	1046.6	30.2	4024.4
2012			760.0	1470.0	727.0	0.0	540.0	585.2	1125.3	28.8	4053.2
2013			774.9	1484.0	756.0	0.0	589.1	619.1	1208.4	27.3	4080.5
2014			791.1	1500.0	787.0	0.0	643.7	655.1	1298.8	26.0	4106.6
2015			807.0	1515.0	818.0	0.0	702.1	693.2	1395.3	24.7	4131.2

CASE 3

- HYDRO DIESEL ALTERNATIVE

HYDL - TABLE 4 OF 4

HY-DL HARYS HARBOUR ----+-- COST PROJECTIONS

YEAR	TOTAL KW INSTALLED	TOTAL KW FIRM	FORECAST Ks	FORECAST HYDRO MWH	FORECAST DIESEL MWH	CAPITAL EXPEND. ($X1000)	OPERATIONAL COSTS FUEL+LUBE ($X1000)	OPERATIONAL COSTS TOTAL O&M ($X1000)	TOTAL COST ($X1000)	P.W. COST ($X1000)	CUMUL. P.W. COST ($X1000)
1984	400.0	500.0	347.0	0.0	1003.0	0.0	154.3	126.7	244.0	240.2	240.2
1985	1080.0	500.0	389.1	0.0	1067.0	0.0	178.9	138.0	316.9	248.2	488.4
1986			404.0	0.0	1160.0	3326.4	208.1	148.9	3083.3	2552.7	3041.2
1987			423.1	1003.0	160.0	0.0	30.3	136.3	166.6	102.2	3143.4
1988			441.2	1103.0	181.0	0.0	47.4	149.2	196.5	95.5	3238.9
1989			455.9	1124.0	194.0	0.0	42.4	156.1	198.5	85.3	3324.2
1990			468.0	1146.0	207.0	0.0	48.4	165.3	213.6	80.8	3405.0
1991			481.5	1168.0	224.0	0.0	55.1	174.2	229.4	86.3	3491.3
1992			496.4	1194.0	241.0	0.0	62.7	183.5	246.2	82.9	3574.2
1993			509.9	1216.0	258.0	0.0	70.7	193.2	263.8	77.7	3651.9
1994			524.4	1236.0	280.0	0.0	81.2	204.1	285.4	74.4	3726.3
1995			534.8	1246.0	298.0	0.0	91.2	215.5	306.7	70.8	3797.1
1996			545.6	1263.0	314.0	0.0	102.1	228.0	330.1	67.4	3864.5
1997			555.2	1272.0	326.0	0.0	112.6	241.0	353.6	65.9	3931.4
1998			566.6	1288.0	340.0	0.0	126.1	254.7	380.8	66.9	3998.3
1999			577.0	1298.0	370.0	0.0	139.7	268.8	408.2	67.8	4066.0
2000			588.1	1309.0	391.0	0.0	155.3	283.3	438.7	64.5	4130.5
2001			599.5	1319.0	414.0	0.0	172.6	299.5	472.0	62.7	4193.2
2002			611.6	1333.0	435.0	0.0	190.4	316.4	506.7	59.7	4252.9
2003			624.4	1344.0	461.0	0.0	211.6	334.6	546.2	57.4	4310.3
2004			636.2	1356.0	483.0	0.0	232.6	353.6	586.2	55.0	4365.3
2005			649.0	1369.0	507.0	0.0	256.2	373.7	630.0	52.6	4417.9
2006			662.1	1382.0	532.0	0.0	282.1	395.1	677.2	50.7	4468.6
2007			674.9	1395.0	556.0	0.0	309.4	417.7	727.0	50.7	4519.3
2008			688.0	1406.0	583.0	0.0	340.4	441.7	782.1	50.8	4570.1
2009			701.9	1417.0	612.0	0.0	375.0	467.3	842.3	50.1	4620.2
2010			716.1	1430.0	640.0	0.0	411.5	494.3	905.8	33.4	4653.6
2011			730.9	1443.0	670.0	0.0	452.0	523.1	975.1	31.8	4685.4
2012			745.1	1457.0	697.0	0.0	493.4	553.1	1046.6	30.2	4715.6
2013			760.0	1470.0	727.0	0.0	540.0	585.2	1125.3	28.8	4744.4
2014			774.9	1484.0	756.0	0.0	589.3	619.1	1208.4	27.3	4771.7
2015			791.1	1500.0	787.0	0.0	643.7	656.1	1299.8	26.0	4797.7
2016			807.0	1515.0	816.0	0.0	702.1	693.2	1395.3	24.7	4822.5

CASE 4

- HYDRO DIESEL ALTERNATIVE

DSL1 - TABLE 4 OF 4

HABYS HARBOUR DIESEL PLANT COST PROJECTIONS

YEAR	DIESEL PROJECTION INSTAL. KW	DIESEL PROJECTION FIRM KW	DIESEL PROJECTION LOAD KW	DIESEL PROJECTION ENERGY MWH	CAPITAL EXPEND. (000)	OPERATIONAL COSTS FUEL+ LUBE (000)	OPERATIONAL COSTS ** SALARIES & MAINT. (000)	TOTAL COST (000)	PRESENT WORTH COST (000)	CUMULATIVE PRESENT WORTH COST (000)
1983	800.0	600.0	347.0	1003.0	0.0	164.3	129.7	294.0	260.2	260.2
1984			369.1	1067.0	0.0	178.9	138.0	316.9	248.2	508.4
1985			404.0	1168.0	0.0	208.1	148.9	356.9	247.4	755.8
1986			423.1	1223.0	0.0	232.0	159.5	391.5	240.1	995.9
1987			444.2	1284.0	0.0	265.1	171.9	437.1	237.2	1233.1
1988			455.9	1318.0	0.0	288.3	184.5	472.7	227.1	1460.2
1989			466.0	1353.0	0.0	316.1	196.0	512.1	212.7	1672.9
1990			481.5	1392.0	0.0	342.6	207.4	550.0	206.9	1884.8
1991			496.4	1435.0	0.0	373.4	219.3	592.6	197.3	2082.0
1992	1100.0	800.0	509.9	1474.0	312.2	403.7	231.5	647.4	279.1	2361.1
1993			524.1	1516.0	0.0	439.8	245.3	685.2	178.6	2539.8
1994			534.8	1546.0	0.0	473.2	259.4	732.6	169.0	2708.8
1995			546.5	1577.0	0.0	512.7	274.9	787.7	160.8	2869.6
1996			555.2	1605.0	0.0	549.1	291.1	840.2	151.8	3021.4
1997			566.6	1638.0	0.0	590.2	308.1	898.3	143.6	3165.0
1998			577.0	1668.0	0.0	629.9	325.0	954.9	135.1	3300.1
1999			588.1	1700.0	0.0	675.3	343.4	1018.7	127.6	3427.7
2000			599.5	1733.0	0.0	722.4	363.3	1085.7	120.3	3548.0
2001			611.6	1768.0	0.0	773.3	384.4	1157.7	113.5	3661.5
2002			624.4	1805.0	0.0	828.5	406.9	1235.3	107.2	3768.7
2003			636.2	1839.0	0.0	885.7	430.4	1316.1	101.1	3869.8
2004			649.0	1876.0	0.0	948.1	455.5	1403.7	95.4	3965.2
2005			662.1	1914.0	0.0	1015.0	482.2	1497.2	90.0	4055.3
2006			674.5	1951.0	0.0	1085.6	510.3	1596.0	84.9	4140.2
2007			688.0	1989.0	0.0	1161.4	540.2	1701.6	80.1	4220.4
2008			701.9	2029.0	0.0	1243.2	571.9	1815.1	75.7	4296.0
2009			716.1	2070.0	0.0	1330.9	605.6	1936.5	71.4	4367.4
2010			730.9	2113.0	0.0	1425.5	641.4	2066.9	67.5	4434.9
2011			746.1	2156.0	0.0	1524.9	679.1	2203.9	63.7	4498.6
2012			760.0	2197.0	0.0	1632.0	719.2	2351.2	60.1	4558.7
2013			774.9	2240.0	0.0	1746.1	761.6	2507.7	56.7	4615.4
2014			791.1	2287.0	0.0	1870.6	807.0	2677.6	53.6	4669.0
2015	1107.0	807.0	807.0	2333.0	22.8	2002.4	854.9	2880.2	51.0	4720.1

CASE 5

- DIESEL ALTERNATIVE

HYDL - TABLE 4 OF 4

HY-DL HARYS HARBOUR ——— COST PROJECTIONS

YEAR	TOTAL Kw INSTALLED	TOTAL Kw FIRM	FORECAST Kw	FORECAST HYDRO MWH	FORECAST DIESEL MWH	CAPITAL EXPEND. ($X1000)	OPERATIONAL COSTS FUEL+LUBE ($X1000)	OPERATIONAL COSTS TOTAL O&M ($X1000)	TOTAL COST ($X1000)	P.W. COST ($X1000)	CUMUL. P.W. COST ($X1000)
1983	800.0	500.0	347.0	0.0	1003.0	0.0	164.3	129.7	294.0	260.2	260.2
1984			369.1	0.0	1067.0	0.0	178.9	138.0	316.9	248.2	508.4
1985			404.0	0.0	1168.0	3024.0	208.1	148.9	3380.9	2343.2	2851.6
1986	1080.0	530.0	423.1	1063.0	160.0	0.0	30.3	136.3	166.6	102.2	2953.8
1987			444.2	1103.0	181.0	0.0	37.4	145.9	183.3	99.5	3053.3
1988			455.9	1124.0	194.0	0.0	42.4	156.1	198.5	95.3	3148.6
1989			468.0	1146.0	207.0	0.0	48.4	165.3	213.6	90.8	3239.4
1990			481.5	1168.0	224.0	0.0	55.1	174.2	229.4	86.3	3325.7
1991			496.4	1184.0	241.0	0.0	62.7	183.5	246.2	82.0	3407.6
1992			509.9	1210.0	258.0	0.0	70.7	193.2	263.8	77.7	3485.4
1993			524.4	1230.0	280.0	0.0	81.2	204.1	285.4	74.4	3559.8
1994	1357.0	807.0	534.8	1248.0	298.0	317.3	91.2	215.8	624.0	144.0	3703.7
1995			545.5	1263.0	314.0	0.0	102.1	228.0	330.1	67.4	3771.1
1996			558.2	1276.0	326.0	0.0	112.6	241.0	353.6	63.9	3835.0
1997			566.6	1288.0	340.0	0.0	126.1	254.7	380.8	60.9	3895.9
1998			577.0	1298.0	370.0	0.0	139.7	268.5	408.2	57.8	3953.6
1999			588.1	1309.0	391.0	0.0	156.3	283.3	439.7	54.9	4008.6
2000			599.5	1319.0	414.0	0.0	172.6	299.5	472.0	52.3	4060.9
2001			611.0	1333.0	435.0	0.0	190.3	316.4	506.7	49.7	4110.6
2002			624.4	1344.0	461.0	0.0	211.6	334.6	546.2	47.4	4157.9
2003			636.2	1366.0	483.0	0.0	232.6	353.6	586.2	45.0	4203.0
2004			649.0	1369.0	507.0	0.0	256.2	373.7	630.0	42.8	4245.8
2005			662.1	1382.0	532.0	0.0	282.1	395.1	677.2	40.7	4286.5
2006			674.9	1395.0	556.0	0.0	309.4	417.7	727.0	38.7	4325.2
2007			688.0	1406.0	583.0	0.0	340.4	441.7	782.1	36.8	4362.0
2008			701.9	1417.0	612.0	0.0	375.0	467.3	842.3	35.1	4397.2
2009			716.1	1430.0	640.0	0.0	411.5	494.3	905.8	33.4	4430.6
2010			730.9	1443.0	670.0	0.0	452.0	523.1	975.1	31.8	4462.4
2011			748.1	1457.0	697.0	0.0	493.4	553.1	1046.6	30.2	4492.6
2012			760.0	1470.0	727.0	0.0	540.0	585.2	1125.3	28.8	4521.4
2013			774.9	1484.0	756.0	0.0	589.3	619.1	1208.4	27.3	4548.7
2014			791.1	1500.0	787.0	0.0	643.7	654.1	1298.8	26.0	4574.7
2015			807.0	1515.0	818.0	0.0	702.1	693.2	1395.3	24.7	4599.4

CASE 5

- HYDRO DIESEL ALTERNATIVE

DSL1 - TABLE 4 OF 4

HARYS HARBOUR DIESEL PLANT COST PROJECTIONS

YEAR	DIESEL PROJECTION INSTAL. KW	DIESEL PROJECTION FIRM KW	DIESEL PROJECTION LOAD KW	DIESEL PROJECTION ENERGY MWH	CAPITAL EXPEND. (000)	OPERATIONAL COSTS FUEL + LUBE (000)	OPERATIONAL COSTS ** SALARIES & MAINT. ** (000)	TOTAL COST (000)	PRESENT WORTH COST (000)	CUMULATIVE PRESENT WORTH COST (000)
1983	800.0	500.0	347.0	1003.0	0.0	164.3	129.7	294.0	264.9	264.9
1984			369.1	1067.0	0.0	176.9	139.0	316.9	257.2	522.1
1985			404.0	1168.0	0.0	208.1	148.9	356.9	261.0	783.1
1986			423.1	1223.0	0.0	232.0	159.5	391.5	257.9	1041.0
1987			444.2	1284.0	0.0	265.1	171.9	437.1	259.4	1300.4
1988			456.9	1318.0	0.0	288.3	184.5	472.7	252.7	1553.1
1989			468.0	1353.0	0.0	310.1	196.0	512.1	246.7	1799.8
1990			481.5	1392.0	0.0	342.6	207.4	550.0	238.7	2038.5
1991			496.4	1435.0	0.0	373.4	219.3	592.6	231.7	2270.1
1992			509.9	1474.0	0.0	403.7	231.6	635.2	223.7	2493.8
1993			524.4	1516.0	0.0	439.8	245.3	685.2	217.4	2711.2
1994			534.8	1546.0	0.0	473.2	259.4	732.5	209.4	2920.6
1995			545.5	1577.0	0.0	512.7	274.9	787.7	202.8	3123.5
1996			555.2	1605.0	0.0	549.1	291.1	840.2	194.9	3318.4
1997			566.6	1638.0	0.0	590.2	308.1	898.3	187.7	3506.1
1998			577.0	1668.0	0.0	629.9	325.0	954.9	179.8	3685.9
1999			588.1	1700.0	0.0	675.3	343.4	1018.7	172.8	3858.8
2000			599.5	1733.0	0.0	722.4	363.3	1085.7	165.9	4024.7
2001			611.6	1768.0	0.0	773.3	384.4	1157.7	159.4	4184.1
2002			624.4	1805.0	0.0	828.5	406.9	1235.3	153.2	4337.3
2003			636.2	1839.0	0.0	885.7	430.4	1316.1	147.1	4484.3
2004			649.0	1876.0	0.0	948.1	455.5	1403.7	141.3	4625.6
2005			662.1	1914.0	0.0	1015.0	482.2	1497.2	135.8	4761.4
2006			674.9	1951.0	0.0	1085.6	510.3	1596.0	130.4	4891.8
2007			688.0	1989.0	0.0	1161.4	540.2	1701.6	125.2	5017.1
2008			701.9	2029.0	0.0	1243.2	571.9	1815.1	120.4	5137.4
2009			716.1	2070.0	0.0	1330.9	605.6	1936.5	115.7	5253.1
2010			730.9	2113.0	0.0	1425.5	641.4	2066.9	111.2	5364.4
2011			745.1	2154.0	0.0	1524.9	679.1	2203.9	106.9	5471.2
2012			760.0	2197.0	0.0	1632.0	719.2	2351.2	102.7	5573.9
2013			774.9	2240.0	0.0	1746.1	761.6	2507.7	98.7	5672.6
2014			791.1	2287.0	0.0	1870.6	807.0	2677.6	94.9	5767.6
2015			807.0	2333.0	0.0	2002.4	854.9	2857.3	91.3	5858.8

CASE 6

- DIESEL ALTERNATIVE

HYDL - TABLE 4 OF 4

HY-DL HARYS HARBOUR CUST PROJECTIONS

YEAR	TOTAL KW INSTALLED	TOTAL KW FIRM	FORECAST KW	FORECAST HYDRO MWH	FORECAST DIESEL MWH	CAPITAL EXPEND. ($X1000)	OPERATIONAL COSTS FUEL+LUBE ($X1000)	OPERATIONAL COSTS TOTAL OGM ($X1000)	TOTAL COST ($X1000)	P.W. COST ($X1000)	CUMUL. P.W. COST ($X1000)
1983	800.0	500.0	347.0	0.0	1003.0	0.0	164.3	129.7	294.0	264.9	264.9
1984			369.1	0.0	1067.0	0.0	170.9	138.0	316.9	257.2	522.1
1985	1080.0	500.0	404.0	0.0	1168.0	3024.0	208.1	148.9	3380.9	2472.1	2994.2
1986			423.1	1063.0	160.0	0.0	30.3	136.3	166.6	109.8	3104.0
1987			444.2	1103.0	181.0	0.0	37.4	145.9	183.3	108.8	3212.8
1988			455.9	1124.0	194.0	0.0	42.4	156.1	198.5	106.1	3318.9
1989			468.0	1146.0	207.0	0.0	48.4	165.3	213.6	102.9	3421.8
1990			481.5	1168.0	224.0	0.0	55.1	174.2	229.4	99.5	3521.3
1991			496.4	1194.0	241.0	0.0	62.7	183.5	246.2	96.3	3617.6
1992			509.9	1216.0	258.0	0.0	70.7	193.2	263.8	92.9	3710.6
1993			524.4	1236.0	280.0	0.0	81.2	204.1	285.4	90.5	3801.0
1994			534.8	1248.0	298.0	0.0	91.2	215.5	306.7	87.7	3888.7
1995			548.5	1263.0	314.0	0.0	102.1	228.0	330.1	85.0	3973.7
1996			555.2	1276.0	329.0	0.0	112.6	241.0	353.6	82.0	4055.7
1997			566.6	1288.0	350.0	0.0	126.1	254.7	380.8	79.6	4135.3
1998			577.0	1298.0	370.0	0.0	139.7	268.5	408.2	76.9	4212.2
1999			588.1	1309.0	391.0	0.0	155.3	283.3	438.7	74.4	4286.6
2000			599.5	1319.0	414.0	0.0	172.6	299.5	472.0	72.1	4358.7
2001			611.6	1333.0	435.0	0.0	190.3	316.4	506.7	69.8	4428.5
2002			624.4	1344.0	461.0	0.0	211.6	334.6	546.2	67.7	4496.2
2003			636.2	1356.0	483.0	0.0	232.6	353.6	586.2	65.5	4561.7
2004			649.0	1369.0	507.0	0.0	256.2	373.7	630.0	63.4	4625.1
2005			662.1	1382.0	532.0	0.0	282.1	395.1	677.2	61.4	4686.6
2006			674.9	1395.0	556.0	0.0	309.4	417.7	727.0	59.4	4746.0
2007			688.0	1406.0	583.0	0.0	340.4	441.7	782.1	57.6	4803.5
2008			701.9	1417.0	612.0	0.0	375.0	467.3	842.3	55.9	4859.4
2009			716.1	1430.0	640.0	0.0	411.5	494.3	905.8	54.1	4913.5
2010			730.9	1443.0	670.0	0.0	452.0	523.1	975.1	52.5	4966.0
2011			745.1	1457.0	697.0	0.0	493.4	553.1	1046.6	50.7	5016.7
2012			760.0	1470.0	727.0	0.0	540.0	585.2	1125.3	49.2	5065.9
2013			774.9	1484.0	756.0	0.0	589.3	619.1	1208.4	47.6	5113.4
2014			791.1	1500.0	787.0	0.0	643.7	655.1	1298.8	46.0	5159.5
2015			807.0	1515.0	818.0	0.0	702.1	693.2	1395.3	44.6	5204.0

CASE 6

- HYDRO DIESEL ALTERNATIVE

DSL1 - TABLE 4 OF 4

MARYS HARBOUR DIESEL PLANT COST PROJECTIONS

YEAR	DIESEL PROJECTION INSTAL. KW	DIESEL PROJECTION FIRM KW	DIESEL PROJECTION LOAD KW	DIESEL PROJECTION ENERGY MWH	CAPITAL EXPEND. (000)	OPERATIONAL COSTS FUEL+ LUBE (000)	OPERATIONAL COSTS ** SALARIES & MAINT. ** (000)	TOTAL COST (000)	PRESENT WORTH COST (000)	CUMULATIVE PRESENT WORTH COST (000)
1983	800.0	500.0	347.0	1003.0	0.0	164.3	129.7	294.0	265.7	265.7
1984			369.1	1067.0	0.0	178.9	138.0	316.9	239.7	495.3
1985			404.0	1168.0	0.0	208.1	148.9	356.9	234.7	730.0
1986			423.1	1223.0	0.0	232.0	159.5	391.6	223.8	953.9
1987			444.2	1284.0	0.0	265.1	171.9	437.1	217.3	1171.2
1988			465.9	1318.0	0.0	288.3	184.5	472.7	204.4	1375.5
1989			488.0	1353.0	0.0	316.1	196.0	512.1	192.5	1568.1
1990			481.5	1392.0	0.0	342.6	207.4	550.0	179.8	1747.9
1991			496.4	1435.0	0.0	373.4	219.3	592.6	168.5	1916.3
1992			509.9	1474.0	0.0	403.7	231.5	635.2	157.0	2073.3
1993			524.4	1516.0	0.0	439.8	245.3	685.2	147.3	2220.6
1994			534.8	1546.0	0.0	473.2	259.4	732.5	136.9	2357.5
1995			545.5	1577.0	0.0	512.7	274.9	787.7	128.0	2485.5
1996			555.2	1605.0	0.0	549.1	291.1	840.2	118.8	2604.3
1997			566.6	1638.0	0.0	590.2	308.1	898.3	110.4	2714.7
1998			577.0	1668.0	0.0	629.9	325.0	954.9	102.1	2816.7
1999			588.1	1700.0	0.0	675.3	343.4	1018.7	94.7	2911.4
2000			599.6	1733.0	0.0	722.4	363.3	1085.7	87.7	2999.1
2001			611.6	1768.0	0.0	773.3	384.4	1157.7	81.3	3080.5
2002			624.4	1805.0	0.0	828.5	406.9	1235.3	75.8	3156.0
2003			636.2	1839.0	0.0	885.7	430.4	1316.1	69.9	3225.9
2004			649.0	1876.0	0.0	948.1	455.5	1403.7	64.8	3290.7
2005			662.1	1914.0	0.0	1015.0	482.2	1497.2	60.1	3350.9
2006			674.9	1951.0	0.0	1085.6	510.3	1596.0	55.8	3406.6
2007			688.0	1989.0	0.0	1161.4	540.2	1701.6	51.7	3458.3
2008			701.9	2029.0	0.0	1243.2	571.9	1815.1	47.9	3506.3
2009			716.1	2070.0	0.0	1330.9	605.6	1936.5	44.5	3550.8
2010			730.9	2113.0	0.0	1425.5	641.4	2066.9	41.3	3592.0
2011			745.1	2154.0	0.0	1524.9	679.1	2203.9	38.3	3630.3
2012			760.0	2197.0	0.0	1632.0	719.2	2351.2	35.5	3665.8
2013			774.9	2240.0	0.0	1746.1	761.6	2507.7	32.9	3698.8
2014			791.1	2287.0	0.0	1870.6	807.0	2677.6	30.6	3729.3
2015			807.0	2333.0	0.0	2002.4	854.9	2857.3	28.4	3757.7

CASE 7

- DIESEL ALTERNATIVE

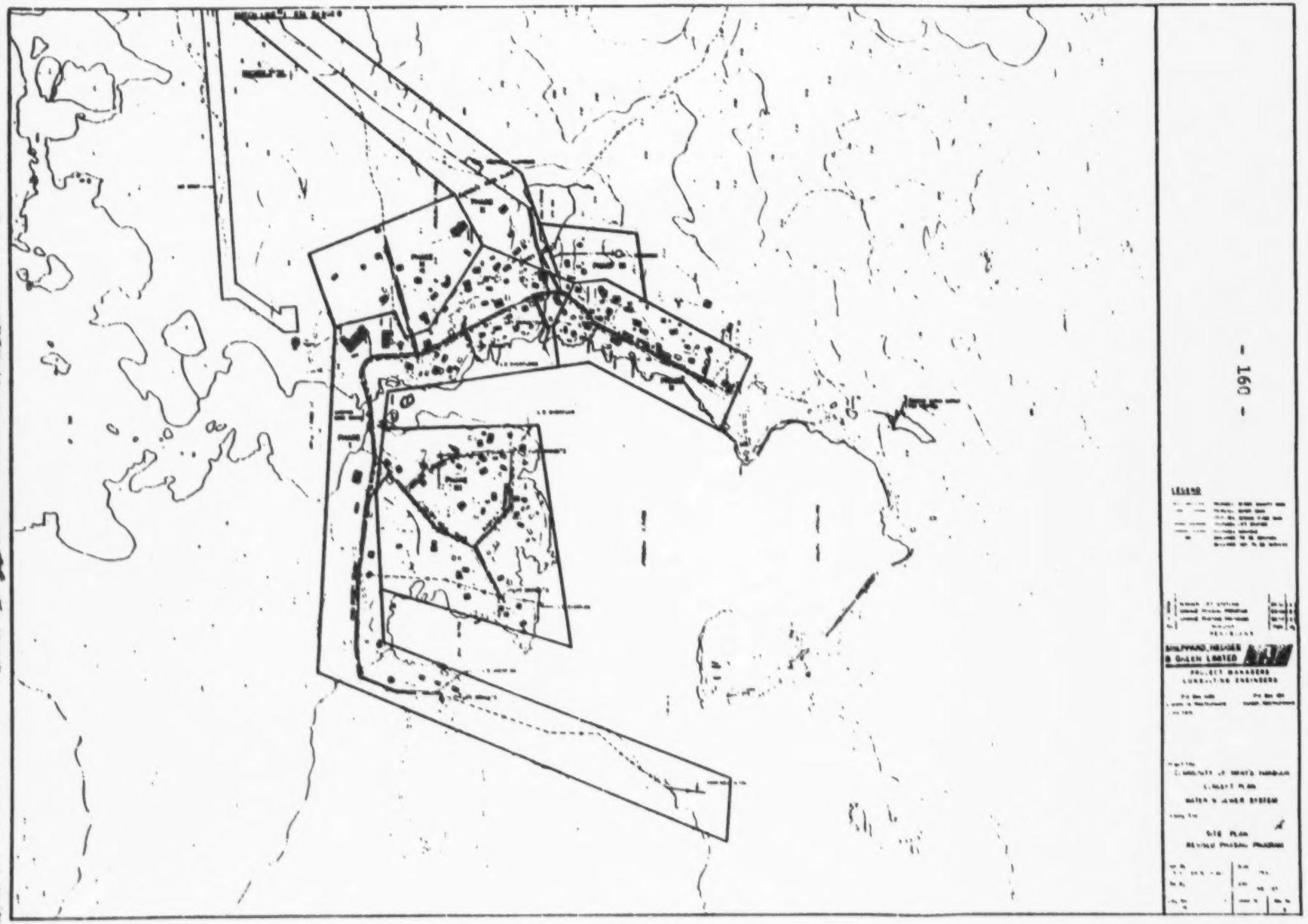
HYDL - TABLE 4 OF 4

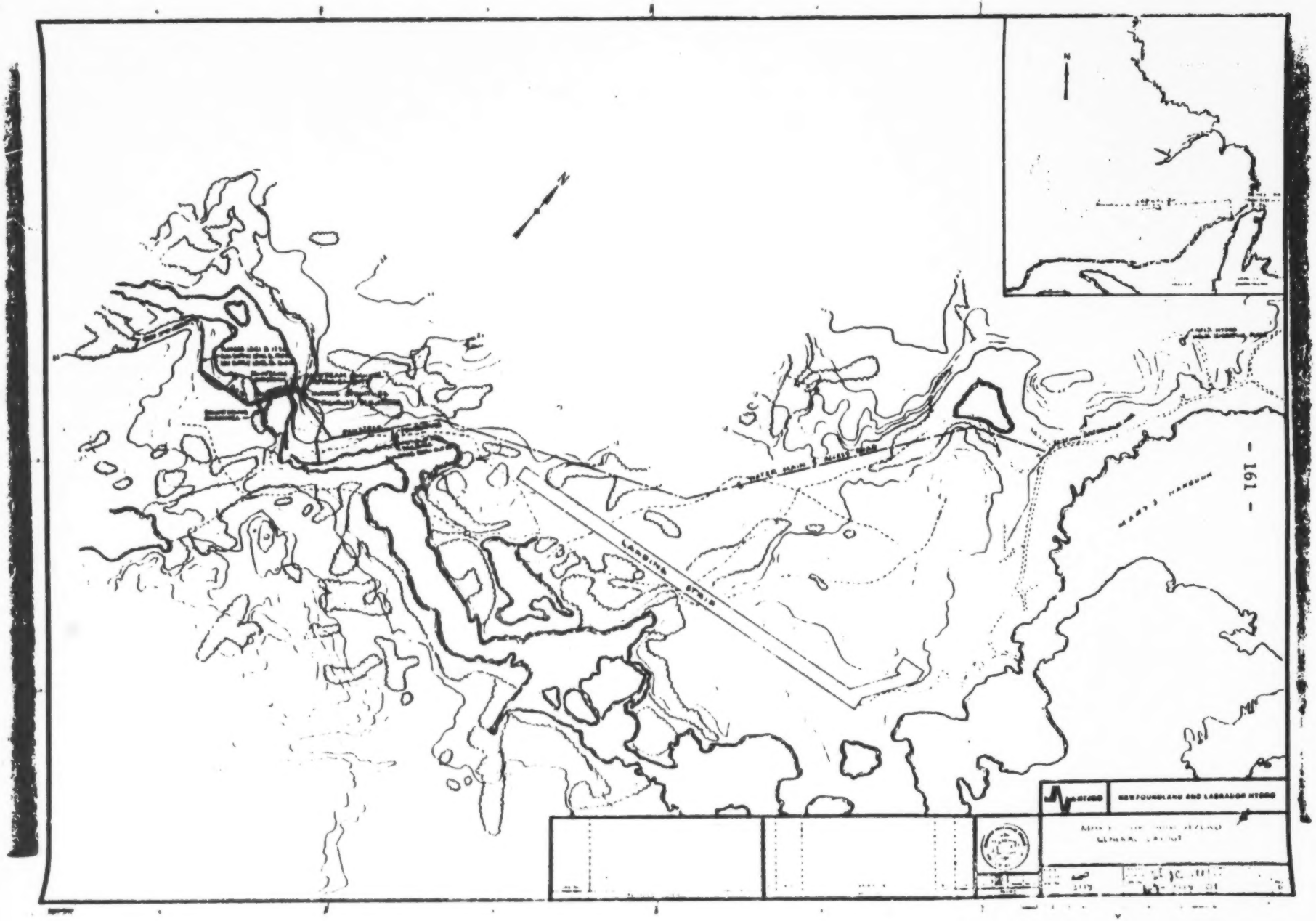
HY-DL MARYS HARBOUR ------- COST PROJECTIONS

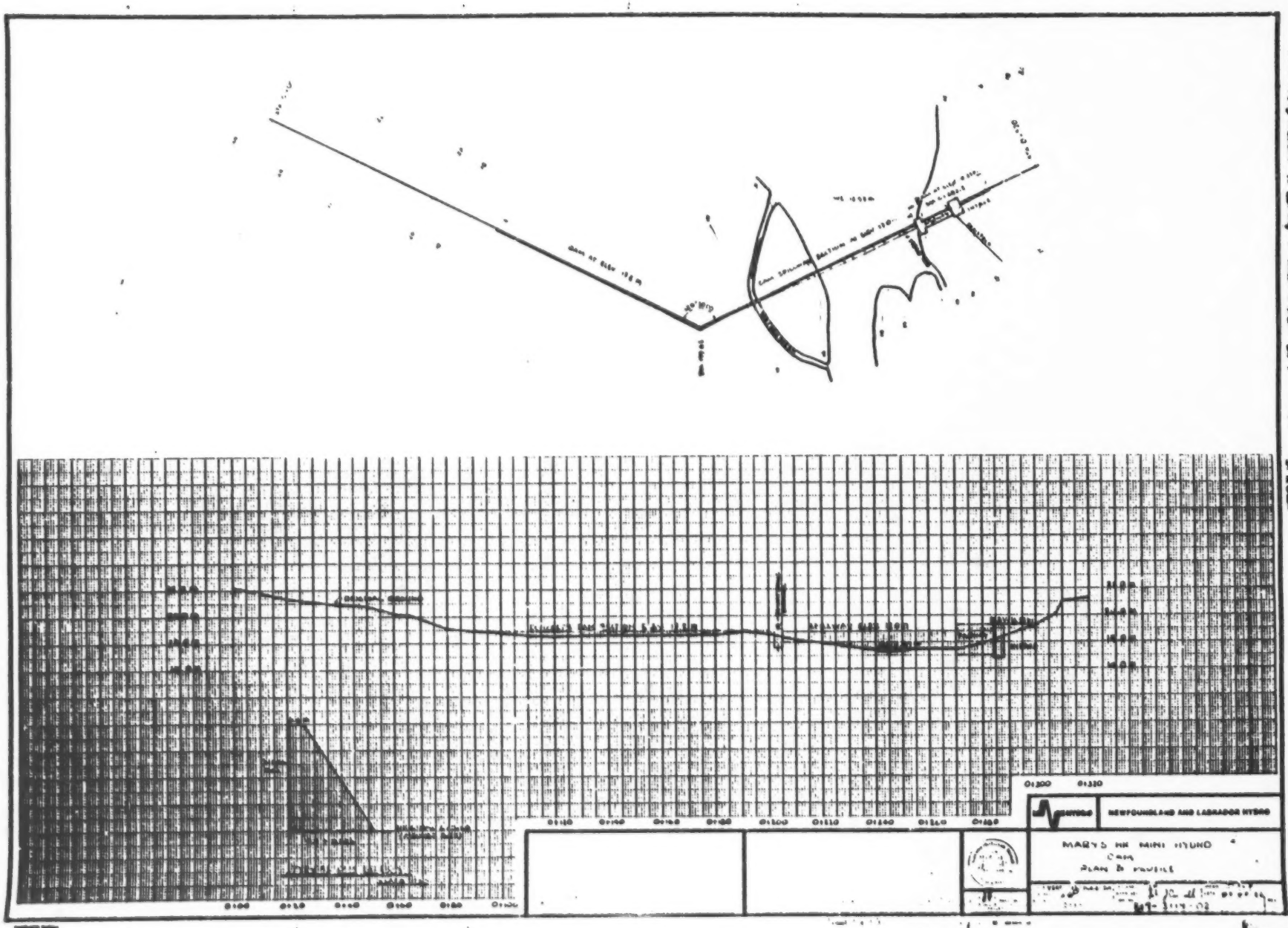
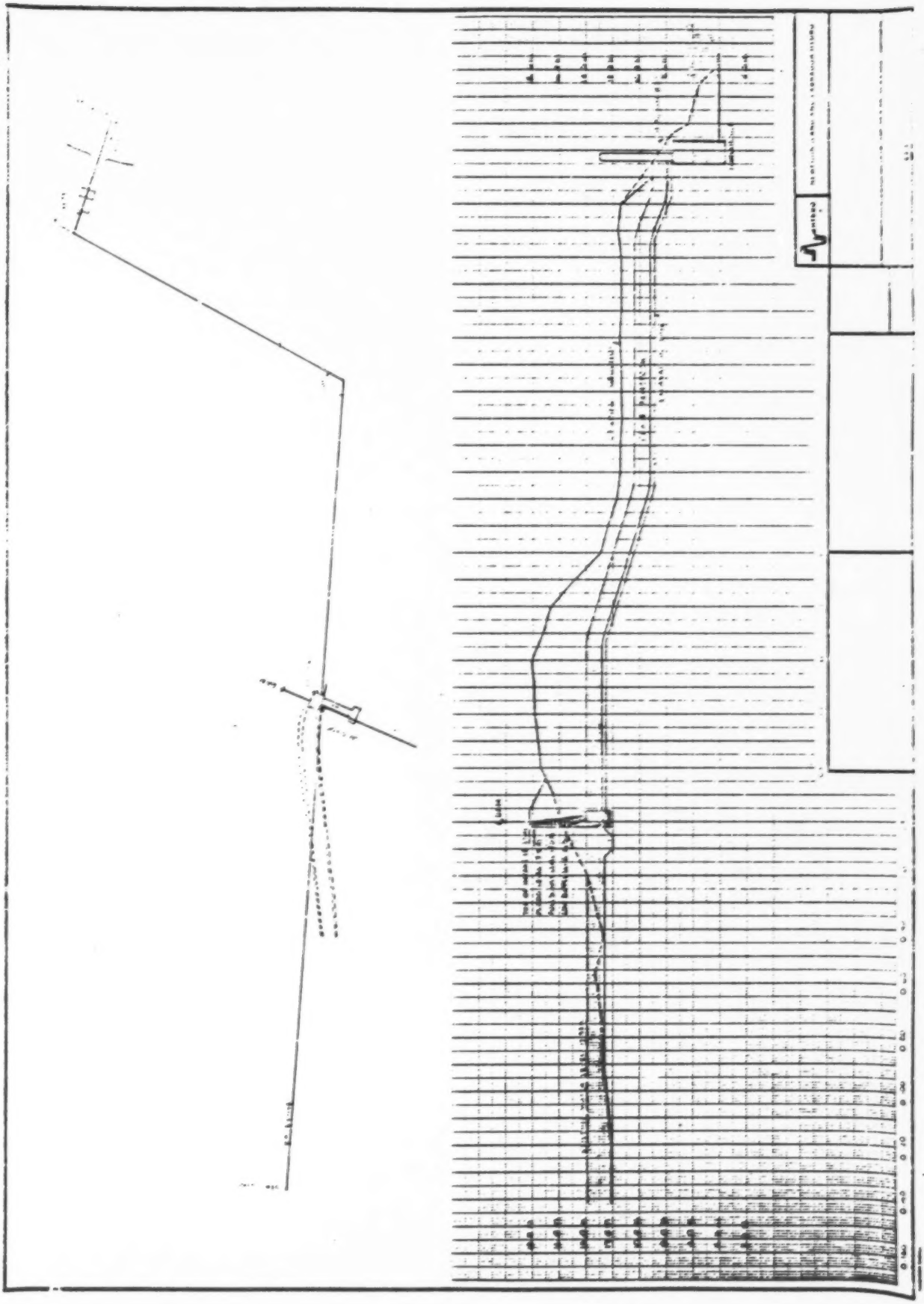
YEAR	TOTAL KW INSTALLED	TOTAL KW FIRM	FORECAST KW	FORECAST HYDRO MWH	FORECAST DIESEL MWH	CAPITAL EXPEND. ($X1000)	OPERATIONAL COSTS FUEL+LUBE ($X1000)	OPERATIONAL COSTS TOTAL O&M ($X1000)	TOTAL COST ($X1000)	P.W. COST ($X1000)	CUMUL. P.W. COST ($X1000)
1983	800.0	500.0	347.0	0.0	1003.0	0.0	164.3	129.7	294.0	255.7	255.7
1984			369.1	0.0	1067.0	0.0	178.9	138.0	316.9	239.7	495.3
1985	1080.0	500.0	404.0	0.0	1168.0	3024.0	208.1	148.9	3380.9	2223.0	2718.4
1986			423.1	1063.0	160.0	0.0	30.3	136.3	166.6	95.3	2813.6
1987			444.2	1103.0	181.0	0.0	37.4	145.9	183.3	91.1	2904.8
1988			455.9	1124.0	194.0	0.0	42.4	156.1	198.5	85.8	2990.6
1989			468.0	1146.0	207.0	0.0	48.4	165.3	213.6	80.3	3070.9
1990			481.5	1168.0	224.0	0.0	55.1	174.2	229.4	75.0	3145.8
1991			496.4	1194.0	241.0	0.0	62.7	183.5	246.2	70.0	3215.8
1992			509.9	1214.0	258.0	0.0	70.7	193.2	263.8	65.2	3281.1
1993			524.4	1236.0	280.0	0.0	81.2	204.1	285.4	61.3	3342.4
1994			534.8	1248.0	298.0	0.0	91.2	215.5	306.7	57.3	3399.7
1995			545.5	1263.0	314.0	0.0	102.1	228.0	330.1	53.6	3453.4
1996			555.2	1276.0	329.0	0.0	112.6	241.0	353.6	50.0	3503.3
1997			566.6	1288.0	350.0	0.0	126.1	254.7	380.8	46.8	3550.1
1998			577.0	1298.0	370.0	0.0	139.7	268.5	408.2	43.6	3593.8
1999			588.1	1309.0	391.0	0.0	155.3	283.3	438.7	40.8	3634.5
2000			599.5	1319.0	414.0	0.0	172.6	299.5	472.0	38.1	3672.7
2001			611.6	1333.0	436.0	0.0	190.3	316.4	506.7	35.6	3708.3
2002			624.4	1344.0	461.0	0.0	211.6	334.6	546.2	33.4	3741.6
2003			636.2	1356.0	483.0	0.0	232.6	353.6	586.2	31.1	3772.8
2004			649.0	1369.0	507.0	0.0	256.2	373.7	630.0	29.1	3801.9
2005			662.1	1382.0	532.0	0.0	282.1	395.1	677.2	27.2	3829.1
2006			674.9	1395.0	556.0	0.0	309.4	417.7	727.0	25.4	3854.5
2007			688.0	1406.0	583.0	0.0	340.4	441.7	782.1	23.8	3878.2
2008			701.9	1417.0	612.0	0.0	375.0	467.3	842.3	22.3	3900.6
2009			716.1	1430.0	640.0	0.0	411.5	494.3	905.8	20.8	3921.3
2010			730.9	1443.0	670.0	0.0	452.0	523.1	975.1	19.5	3940.8
2011			745.1	1457.0	697.0	0.0	493.4	553.1	1046.6	18.2	3959.0
2012			760.0	1470.0	727.0	0.0	540.0	585.2	1125.3	17.0	3976.0
2013			774.9	1484.0	756.0	0.0	589.3	619.1	1208.4	15.9	3991.8
2014			791.1	1500.0	787.0	0.0	643.7	655.1	1298.8	14.8	4006.7
2015			807.0	1515.0	818.0	0.0	702.1	693.2	1395.3	13.9	4020.5

CASE 7

- HYDRO DIESEL ALTERNATIVE




LABRINA CREEK
NEWFOUNDLAND AND LABRADOR HYDRO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